Appendix H

Traffic and Transportation

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This appendix evaluates the potential impacts of onsite and offsite shipments of low-level waste (LLW), mixed low-level waste (MLLW) (including melters), transuranic (TRU) waste (including mixed TRU waste), and immobilized low-activity waste (ILAW); shipments of MLLW from Hanford to offsite treatment facilities and back; and the shipment of construction and capping materials to Hanford. This appendix presents the potential impacts of shipments of LLW, MLLW, and TRU wastes from offsite to Hanford facilities and shipments of TRU wastes from Hanford to the Waste Isolation Pilot Plant (WIPP) for disposal. The potential impacts of shipments of LLW, MLLW, and TRU wastes from offsite to Hanford and TRU wastes from Hanford to WIPP are presented for entire routes across the United States and for the portions of these routes that traverse Washington and Oregon. The methods and data used to conduct these calculations have been updated with respect to the methods and data used in the *Final Waste Management Programmatic Environmental Impact Statement* (WM PEIS) (DOE 1997a). Where possible, data used in the WM PEIS are used in this analysis for consistency. Changes to the data relied on between the WM PEIS and the HSW EIS include the population data (2000 versus 1990 Census), route characteristics (shipping distances and population characteristics along the routes were calculated using a geographic information system [GIS] based software), and waste volume projections. The estimated impacts of transporting TRU wastes to WIPP were reanalyzed using updated methods and data but are consistent with the transportation analysis in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (WIPP SEIS-II) (DOE 1997b).

Estimates of potential radiological and non-radiological impacts of transporting various types of waste are presented in the following sections. This analysis resulted in estimates of radiological hazards from waste transported under incident-free and accident conditions and chemical hazards from waste transportation accidents, as well as physical hazards (that is, fatalities from trauma) from traffic accidents involving waste shipments. Health effects from incident-free vehicular emissions are also estimated. The physical (non-radiological) hazards and the impacts of incident-free vehicular emissions are independent of the cargo being transported. Total integrated radiological and non-radiological impacts are calculated in addition to maximum individual incident-free radiological exposures and the impacts to populations and individuals of the maximum credible accidents. Note that all of the methods used in this appendix to calculate potential transportation impacts are commonly used in U.S. Department of Energy (DOE) environmental documents. In addition, potential impacts of sabotage or acts of terrorism are addressed in this analysis (see Section H.8). Finally, the transportation impacts from the WM PEIS (DOE 1997a) and WIPP SEIS-II (DOE 1997b) are compared to the updated transportation impacts in this HSW EIS.

H.1 Description of Methods

The methods used in this HSW EIS to estimate the impacts of transporting waste, construction materials, and capping materials are described in the following section. Section H.1.1 describes the RADTRAN 5 computer code (Neuhauser et al. 2003) that was used to predict the radiological incident-free doses and accident risks to the public and transport crews associated with the alternative groups examined in this EIS. The method used to calculate physical (non-radiological) incident-free risks is described in Section H.1.2. The method used to calculate non-radiological accident risks is described in Section H.1.3. The method used to calculate the impacts of accidental releases of hazardous chemicals is described in Section H.1.4.

H.1.1 Radiological Impact Analysis Methodology

RADTRAN 5 was used to estimate collective impacts to populations from incident-free transportation of radioactive material and collective population risks from accidents during transport. RADTRAN 5 is organized into nine models:

- package
- transportation (infrastructure)
- population distribution
- accident severity and package behavior
- accident probability
- meteorological dispersion
- exposure pathway
- accident dose risk
- health effects.

RADTRAN 5 uses these models to calculate the potential population dose from incident-free transportation and the risk to the population from potential accident scenarios.

Collective Population Doses from Incident-Free Transport. RADTRAN 5 estimates doses to people on or near the transportation routes from external radiation emitted from the loaded shipping containers. RADTRAN 5 calculates incident-free doses to the following population groups:

- **Persons along the route (referred to as *off-link population*)**. RADTRAN 5 estimates population doses to all persons living or working within 0.8 km (0.5 mi) of each side of a transportation route.

- **Persons sharing the route (*on-link population*)**. Collective doses are estimated for persons in vehicles sharing the transportation route, traveling in the same or opposite direction.

- **Persons at stops**. RADTRAN 5 estimates collective doses to persons who may be exposed to a shipment while it is at a stop. For truck shipments to or from offsite locations, stops may be made for fuel, food, or rest. For onsite truck shipments, stop times are set to zero because of the short transport distances.

- **Crew members**. Incident-free doses to truck crew members are estimated.

The total collective population doses are the sum of the doses to the off-link population, on-link population, and persons at stops. Worker doses include the doses to truck crew members. Note that the population doses resulting from onsite shipments would be to Hanford Site workers that may be adjacent to or near a shipment of radioactive waste. Onsite shipments of radioactive waste would not expose a member of the public to any substantial radioactive dose rate because Hanford Site access restrictions prevent the shipments from approaching locations where a member of the public could be. One exception would be shipments from the 300 Area or 400 Area to the 200 Areas treatment and disposal facilities. The highway from the 300 Area and 400 Area to the Wye Barricade is publicly accessible, and a member of the public could conceivably be on the highway at the time a waste shipment is being transported. However, some shipments of radioactive materials from the 300 Area and 400 Area to the 200 East and 200 West Areas are currently conducted during off-shift hours (for example, nights and weekends) and often require closure of the road between the 300 Area or 400 Area and the Wye Barricade. This is done in some cases to minimize public exposure to the shipments. Consequently, except for this small potential dose to a non-Hanford worker member of the public, the doses to the public referred to in this appendix from onsite shipments are actually doses to Hanford workers who may be driving to or from their work locations as a waste shipment passes by. Doses to the public are associated with shipments of MLLW to offsite treatment facilities and back; shipments of TRU wastes to WIPP; and LLW, MLLW, and TRU shipments from offsite to Hanford.

Incident-free doses estimated by RADTRAN 5 generally are based on extrapolating the dose rate emitted from the package as a function of distance from a point source. The public and worker doses are dependent upon parameters, such as population density, shipping distance, exposure distance, exposure duration, stop times, traffic density, and the Transportation Index (TI), of the package or packages. The TI is defined as the highest package dose rate (mrem per hour) that would be received by an individual located at a distance of 1 m (3.3 ft) from the external surface of the package.

Radiological accident risks. RADTRAN 5 assesses accident risk by combining the probabilities and consequences of accidents to produce a risk value. RADTRAN 5 considers a spectrum of potential transportation accidents, ranging from those with high frequencies and low consequences (for example, fender benders) to those with low frequencies and high consequences (accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

An accident analysis in RADTRAN 5 is performed using an accident severity and package release model. The user can define up to 30 severity categories, with each category increasing in magnitude. Severity categories are related to fire, puncture, crush, and immersion environments created in vehicular accidents. For this analysis, the eight severity categories defined in NUREG-0170 (NRC 1977) were adopted for onsite shipments. Severity Category I represents minor accidents in which the packaging system retains confinement of the cargo (that is, no release). Higher severity categories represent more severe accident conditions with correspondingly higher releases and lower probabilities. The eight accident severity category scheme is consistent with those used in the WM PEIS and WIPP SEIS-II as well as with recommendations given in DOE (2002c).

Each severity category has an assigned conditional probability (or the probability, given an accident occurs, that it will be of the specified severity). The accident scenarios are further defined by allowing the user to input release fractions and aerosol and respirable fractions for each severity category. These fractions are also a function of the physical-chemical properties of the materials being transported. RADTRAN 5 values for materials similar to the various types of waste were used in this analysis. For example, Category 1 solid wastes were modeled as a generic small-powder-material form. Using these values, the Category 1 LLW solids are assigned an aerosol fraction value of 0.10 (that is, 10 percent aerosol-size particles) and a respirable fraction value of 0.05 (5 percent of the aerosol-size particles are also respirable-size particles). These parameters were used for all onsite shipments of solid materials, including Category 1 LLW, Category 3 LLW, MLLW, and TRU wastes.

For accidents that result in a release of radioactive material, RADTRAN 5 assumes the material is dispersed into the environment according to standard Gaussian diffusion models. The code allows the user to choose two different methods for modeling the atmospheric transport of radionuclides after a potential accident. The user can either input Pasquill atmospheric-stability category data or averaged time-integrated concentrations. In this analysis, the default standard cloud option (using time-integrated concentrations) was used.

RADTRAN 5 calculates the population dose from the released radioactive material for five possible exposure pathways. These pathways are

- external dose from exposure to the passing cloud of radioactive material

- external dose from radionuclides deposited on the ground by the passing plume (the analysis included the radiation exposures from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway)

- internal dose from inhalation of airborne radioactive contaminants

- internal dose from resuspension of radioactive materials that were deposited on the ground (the analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures)

- internal dose from ingestion of contaminated food (the analysis assumed interdiction of foodstuffs and evacuation after an accident so no internal dose due to ingestion of contaminated foods was calculated).

Standard radionuclide uptake and dosimetry models are incorporated into RADTRAN 5. The computer code combines the accident consequences and frequencies of each severity category, sums up the severity categories, and then integrates across all the shipments. Accident-risk impacts that are provided in the form of a collective population dose (person-rem over the entire shipping campaign) are then converted to population risk using health-effects conversion factors. The dose to risk factors, which were taken from Federal Guidance Report 13 (Eckerman et al. 1999), assume 6.0E-04 latent cancer fatalities (LCFs) per person-rem for workers and the general public.

Analysis of maximally exposed individuals. A scenario-based analysis was conducted to develop estimates of incident-free radiation doses to maximally exposed individuals (MEIs). The analysis is based on information in DOE (2002a) and incorporates information about exposure times, dose rates, and the number of times an individual may be exposed to an offsite shipment. Adjustments were made where necessary to reflect the waste shipments addressed in this HSW EIS. In all cases, it was assumed that the dose rate emitted from the shipping containers is 10 mrem/hr at 2 m (6.6 ft) from the side of the transport vehicle, the maximum dose rate allowed by U.S. Department of Transportation (DOT) regulations. The actual dose rates emitted from typical waste shipments are likely to be much lower. For example, the average dose rate from historical LLW shipments is about 1 mrem/hr at 1 m (3.3 ft) (DOE 2002a) and would be even lower at 2 m (6.6 ft) from the surface of the shipment. Contact-handled (CH) TRU waste shipment dose rates were estimated in the WIPP SEIS-II (DOE 1997b) for Hanford TRU waste at between 2.2 and 3.3 mrem/hr at 1 m (3.3 ft), and would be even lower at 2 m (6.6 ft) from the shipment. Using the point-source approximation (that is, dose rate is proportional to $1/r^2$ where r is the distance between the radiation source and receptor), the dose rates at 2 m (6.6 ft) from LLW and CH TRU waste shipments would be about one-fourth of the dose rate at 1 m (3.3 ft). Thus as a first-order approximation, the dose rates from actual LLW shipments would be, on average, about 0.25 mrem/hr at 2 m (6.6 ft) and the dose rates from actual CH TRU waste shipments would be about 0.5 to 0.8 mrem/hr at 2 m (6.6 ft) from the shipments. These dose rates are well below the regulatory maximum dose rate assumed in the analysis. For perspective, the radiation dose rates measured at 1 m (3.3 ft) from the recent TRU waste shipments to Hanford were all below 1 mrem/hr and would be even lower at 2 m (6.6 ft) from the shipment. The highest measured dose rates were 30 mrem/hr at the point of contact with the shipment and 0.8 mrem/hr at 1 m (3.3 ft) from the shipment.

An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the Hanford Site. The analysis evaluated the following exposure scenarios:

Truck crew member. Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period of time. The analysis assumed that crew member doses are limited to 2 rem per year (DOE 2002b).

Inspectors. Radioactive waste shipments are inspected by federal or state vehicle inspectors, for example, at state ports of entry. DOE (2002b) assumed that inspectors would be exposed for 1 hour at a distance of 1 m (3.3 ft) from the shipping containers.

Resident. The analysis assumed that a resident lives 30 m (100 ft) from the point where a shipment would pass and would be exposed to all shipments along a particular route. Exposures to residents on a per-shipment basis were extracted from the WIPP SEIS-II (DOE 1997b) and used in the HSW EIS to estimate potential radiation doses to maximally exposed residents.

Individual stuck in traffic. This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for one hour at a distance of 1.2 m (4 ft). The analysis assumed this exposure scenario would occur only one time to any individual.

Person at a truck service station. This scenario estimates doses to an employee at a service station where all truck shipments along a particular route would stop. DOE (2002b) assumed this person is exposed for 49 minutes at a distance of 16 m (52 ft) from the loaded shipping container.

Information was extracted from DOE (2002b) and DOE (1997b) to develop unit dose factors (rem per shipment) that were applied to the shipping data in this HSW EIS to develop the MEI dose impacts (see Section H.3.2.3.1). This is valid because the calculated impacts are functions of dose rate and exposure duration. The calculations do not differentiate between cargo types so the results would be same even though DOE (2002b) addresses commercial spent nuclear fuel, whereas this HSW EIS addresses various forms of solid radioactive wastes. The analyses of maximally exposed individuals in DOE (2002b) and this HSW EIS assumed the dose rate emitted from the shipment was to be at the regulatory limit.

Analysis of maximum credible accidents. The results of an analysis of the impacts to populations and individuals of maximum credible accidents were extracted from DOE (1997b) and summarized in this HSW EIS. The analysis assumed a severe accident involving remote-handled (RH) TRU waste occurred in an urban area. The pure consequences (that is, the consequences are not weighted against the probability of occurrence, as is done in the RADTRAN 5 assessment of radiological accident risks) of this potential accident were then estimated using standard atmospheric dispersion and radiological dose calculation methods.

H.1.2 Physical (Non-Radiological) Incident-Free Risks

Non-radiological incident-free impacts consist of fatalities from pollutants, such as diesel exhaust emitted from vehicles. This category of impacts is not related to the radiological characteristics of the cargo. Spreadsheet calculations were performed using unit-risk factors (fatalities per kilometer of travel) to derive estimates of the non-radiological impacts. The non-radiological impacts were calculated by multiplying the unit risk factors by the total round-trip shipping distances for all of the shipments in each shipping option. Non-radiological unit risk factors for incident-free transport were taken from Biwer and Butler (1999).

H.1.3 Non-Radiological Accident Risks in Transit

The non-radiological accident impacts of traffic accidents associated with the transportation of radioactive waste are assumed to be comparable to the impacts associated with general transportation activities in the United States. A unit factor (fatalities per kilometer or fatalities per mile) is multiplied by the round-trip shipping distance to calculate non-radiological impacts from vehicular accidents. The fatalities are due to vehicular impacts with solid objects, rollovers, or collisions and are not related to the radioactive nature of the cargo being transported. For onsite shipments, the fatality data developed by Saricks and Tompkins (1999) for primary highways in the state of Washington was used in the calculations. Separate unit factors were used to develop estimates of the number of accidents involving the shipments and the number of fatalities resulting from the accidents.

A similar, yet more detailed, approach was used to develop non-radiological accidents and fatality estimates for offsite shipments. The TRAGIS computer code (Johnson and Michelhaugh 2000) was used to develop estimates of the distance traveled in each state along a route and the type of highway (interstate, state highway, or other). Actual routes were used in these analyses. Saricks and Tompkins (1999) provided accident rates and fatality rates that are a function of the highway type. The approach taken to estimate non-radiological impacts of offsite shipments was to multiply the state-level accident or fatality rates by the distances traveled in each state on the corresponding highway type and then sum up all the states on each route. These non-radiological impact analyses assumed round-trip shipments in order to account for shipment of loaded containers and return shipments of empty containers. This is different from the radiological impact analyses, which estimate impacts only when the shipping containers are loaded with radioactive waste. For interstate highways, the actual interstate distances and interstate accident rates were used. For non-interstate highway travel, either the "Primary" or "Other" rates given by Saricks and Tompkins (1999) were used, whichever was greater. For the states of Georgia, New York, Oregon, and South Carolina, Saricks and Tompkins (1999) gives only one accident rate and one fatality rate. These rates were applied to both interstate and non-interstate travel in those specific states.

H.1.4 Hazardous Chemical Impact Analysis

The impact of accidental releases of hazardous chemicals from the various waste shipments was addressed differently from accidental releases of LLW, MLLW, and TRU wastes. A maximum credible accident involving each shipment was postulated. This is similar to the analysis of the impacts of the maximum credible radiological accidents discussed in Section H.1.1. Hazardous chemical release and atmospheric dispersion calculations were then performed to determine the maximum downwind concentration to which an individual would be exposed. The downwind concentrations were compared to safe exposure levels for each chemical (Emergency Response Planning Guidelines [ERPGs] or Temporary Emergency Exposure Limits [TEELs]; see Section H.6) to determine the potential public and worker impacts. Hazardous chemical impacts were calculated for maximally exposed individuals and not for populations. Exposures to other individuals would be to lower concentrations of the hazardous chemicals and thus, if the impacts to the maximally exposed individual do not result in adverse health impacts, the surrounding population would also not be expected to suffer adverse health impacts. This analytical approach is consistent with guidance outlined in the DOE NEPA Compliance Guide (DOE 1998b) and the DOE Transportation Risk Assessment Handbook (DOE 2002a) as well as with the analytical approaches reflected in recent DOE EISs addressing nationwide transportation of radioactive wastes; the WIPP SEIS-II (DOE 1997b) and Yucca Mountain EIS (DOE 2002b).

The formula used to estimate the downwind concentrations of hazardous chemicals is

$$Concentration = \frac{Source\ Inventory \times Respirable\ Release\ Fraction \times \frac{E}{Q}}{Release\ Duration}$$

where E/Q is the atmospheric dispersion coefficient.

Hazardous chemical concentrations for the highest-volume waste streams are presented in Section H.2.3.

The maximum credible accident postulated in this analysis is assumed to involve a severe impact followed by a fire. The impact condition is assumed to break up the waste form and cause the waste container to fail so the contained material has an open pathway to the environment. A fire is then assumed to occur, resulting in additional damage and aerosolization of the waste material. The aerosol and respirable fractions used in the radiological impact analysis also were used to characterize the released hazardous chemicals for the solid waste constituents. For solid chemicals, the aerosol and respirable fractions were set equal to 0.1 and 0.05, respectively. Therefore, a combined respirable release fraction of 0.005 was used in the calculations to characterize releases of solid (that is, powder form) materials. For waste constituents that could volatilize under these conditions, the aerosol and respirable fractions were both set equal to 1.0 (that is, 100 percent of the material is dispersible and 100 percent is respirable).

Because an accident could occur anywhere and at any time during a shipment, predicting the population distributions and weather conditions at the time of the accident is not possible. For this analysis, the concentrations of the hazardous materials at the location of the MEI were calculated using data taken from DOE (1997b). The MEI for onsite and offsite shipments was assumed to be located 100 m (109 yd) downwind from the accident location for the entire duration of the release. The dose to the MEI for offsite shipments would be similar. Downwind air concentrations are also a function of wind speed and atmospheric stability class. The wind speed was assumed to be 1 m/s, and Pasquill Stability Class F (stable conditions) was assumed. These are low-probability wind conditions that tend to overestimate typical concentrations of released materials. Plume rise (that is, loft of the plume resulting from the thermal conditions caused by the fire) was considered. It was assumed that the effective height of the plume would be approximately 21 m (69 ft). The resulting E/Q value was calculated to be 1.13E-04 sec/m^3 (DOE 1997b).

The impacts to the MEI were determined by comparing the downwind concentrations of each hazardous chemical to safe exposure levels. The primary source of the exposure levels is *ERPGs and TEELs for Chemicals of Concern, Rev. 19* (Craig 2002). The safe exposure level assumed here is TEEL-2, as defined by Craig (2002). The TEEL-2 concentration is defined as the maximum concentration in air below which nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

H.2 Solid Waste Shipping Data

This section presents information about waste volumes, number of shipments, packaging characteristics, and route characteristics that were used in the transportation impact analysis. Section H.2.1 presents these data for onsite shipments and Section H.2.2 presents the offsite shipment data.

H.2.1 Onsite Shipping Data

RADTRAN 5 calculations are performed for each origin/destination pair. Onsite population densities and shipping distances are based on Hanford map distances and occupancies in buildings along the routes.

The shipment origins, destinations, distances, and number of shipments to be transported onsite in the alternative groups are presented later in this appendix. The capacities of the various onsite shipment types and other shipment characteristics are shown in Table H.1.

Table H.1. General Shipping Parameters for HSW EIS Solid Waste Shipments

Parameter	Value
Waste volume (m^3 per shipment)[(a)]	
LLW Cat 1	7.5
LLW Cat 3	0.89
MLLW	3.4
CH TRU waste drums	7.5
CH TRU waste boxes	5.7
RH TRU waste	0.89[(b)]
ILAW	2.6 (one canister)
Spent melters (one melter per shipment)	175
Elemental lead and mercury	0.5
Transport Index (dose rate at 1 m from shipping container, mrem/hr)[(c)]	
LLW Cat 1 and MLLW	
LLW Cat 3 and RH MLLW	1[(d)]
CH TRU waste (drums and boxes)	10[(d)]
RH TRU waste	4
ILAW	10
Spent melters	14[(e)]
	14[(e)]
Number of truck crew[(f)]	2
Average vehicular speed (km/hr)[(f)]	
Rural	88
Suburban	40
Urban	24
Stop time (hr/km), number of people exposed while stopped and average exposure distance while stopped	NA (No stops for onsite shipments)
Number of people per vehicle sharing route[(g)]	2
Population densities (persons/km^2)	Route-specific
One-way traffic count (vehicles/hr)[(f)]	
Rural	470
Suburban	780
Urban	2800

(a) Shipment capacities are based on current Hanford shipping practices except where otherwise indicated.
(b) Source: WIPP SEIS-II (DOE 1997b).
(c) Source: WM PEIS (DOE 1997a) except where otherwise indicated.
(d) Source: *A Resource Handbook for DOE Transportation Risk Assessment* (DOE 2002a).
(e) Based on regulatory maximum external dose rate of 10 mrem/hr at 2 m from the shipping container. See 49 CFR 173.441.
(f) Source: RADTRAN default parameter (Neuhauser and Kanipe 1992).
(g) Source: NUREG-0170 (NRC 1977).

Radioactive Waste Shipping Regulations and Packaging

The two key federal government agencies responsible for ensuring the safety of transporting radioactive materials are the U.S. Department of Transportation (DOT) and U.S. Nuclear Regulatory Commission (NRC). DOT regulations for the safe transportation of radioactive materials are found in Title 49 of the Code of Federal Regulations (49 CFR 106-180). NRC transportation regulations are found in 10 CFR 71. These regulations establish a comprehensive set of requirements that ensure appropriate packaging (or shipping container) commensurate with the hazard presented by the shipment is used, vehicle (tractor-trailer, railcar) safety and reliability, route selection, driver training and accreditation, and shipment labeling and placarding in accordance with the level of hazard.

The most important element of safety is the packaging or shipping containers used to transport waste materials. Federal regulations, with which DOE must comply for offsite shipments, establish two types of packaging that will be used for offsite transport of waste materials: Type A and Type B. The levels of radioactivity and the specific radionuclides contained in the wastes determine whether a shipment is transported in a Type A or Type B package. In general, lower-hazard (that is, low-radioactive content) shipments are transported in Type A packages and higher-hazard (high-radioactive content) shipments are transported in Type B packages. Type A packages would be used for most LLW and MLLW shipments. These waste types are characterized by relatively low radiation levels and radionuclide concentrations. Type A packages are required to withstand a series of tests, referred to as normal conditions of transport, without functional failure. Type A packaging tests include a water spray test, drop test, stacking test, and penetration test. Examples of Type A containers used for transporting LLW and MLLW include 208-L (55-gal) steel drums, steel boxes, and various sizes of concrete and steel shielded cylindrical containers. Type B packages, on the other hand, are used for radioactive materials that have relatively high radionuclide concentrations and/or relatively high concentrations of transuranic radionuclides, such as plutonium and americium. TRU waste, some high-curie content LLW and MLLW shipments, and possibly ILAW canisters would be shipped in Type B packages. Type B packages must withstand a series of tests that are designed to simulate severe accidents (including impact, puncture, thermal, and water immersion environments) in addition to the normal conditions of transport. Examples of Type B packages include the massive spent nuclear fuel shipping casks and the TRUPACT container used to transport TRU waste to WIPP. Properly designed, manufactured, tested, and maintained packaging systems are the backbone of DOE's transportation safety program.

Population density information for onsite shipments was obtained from the Spent Nuclear Fuel Programmatic EIS (DOE 1995). It should be noted that these values adequately bound the present and future conditions at Hanford based on the following considerations. First, the populations are assumed to be uniformly distributed on both sides of the roadway for the entire trip. In reality, most Hanford workers would be located within buildings and large fractions of the road pass through uninhabited areas between buildings. Second, many of the Hanford buildings are set back from the most frequently used roadways and there would be few or no people between the road and the building. Third, the largest potential change in Hanford's population since 1995 is due to construction of the Waste Treatment Plant (WTP). The WTP is located on the extreme east end of the 200 East Area, away from most roads that would be used for solid waste transportation. Most of the current WTP construction work force is temporary and will relocate elsewhere after WTP construction is complete in about 2010 and would not be present when most of the shipments addressed under the HSW EIS proposed action and alternatives would take place.

For shipments from unspecified locations to the 200 West Area, it was assumed that the origin of the shipment was the 300 Area, the onsite waste generators farthest from the 200 West Area. These shipments were assumed to travel a one-way distance of 48 km (30 mi) through a region defined by three population densities: 1.6 km (1 mi) through a region with the 300 Area population density (660 persons/km^2 or 1700 persons/mi^2); 6.4 km (4 mi) through a region with the 200 West Area population density (120 persons/km^2 or 300 persons/mi^2); and 40 km (25 mi) through a region with the 600 Area population density (0.14 persons/km^2 or 0.35 persons/mi^2). These route characteristics were also used for shipments of waste to an offsite commercial treatment facility adjacent to the Hanford Site. For intra-200 West Area shipments (for example, from the CWC to WRAP or the T Plant Complex to the LLBGs), a distance of 1.6 km (1 mi) was assumed. Ten percent of route was assumed to travel through an area defined by a population density of 660 persons/km^2 (1700 persons/mi^2) and 90 percent in an area defined by a population density of 0.14 persons/km^2 (0.35 persons/mi^2). Shipments between the 200 East and 200 West Areas (for example, ILAW shipments to a 200 East Area disposal facility in Alternative Group B) were modeled as a 16-km (10-mi) shipment, 10 percent of which would be through an area defined by a population density of 660 persons/km^2 (1700 persons/mi^2) and 90 percent in an area defined by a population density of 0.14 persons/km^2 (0.35 persons/mi^2). This analysis is conservative because most of the onsite personnel will be in buildings located on one side of the road or the other and in buildings that are set back away from the roads, although the code assumes a uniform population density on both sides of the road. Also, many of the shipments will come from the 200 East and 200 West Areas, a much shorter shipping distance than from the 300 Area.

Table H.2 presents the shipping data for Alternative Group A Hanford Only waste volume. The table provides the origin and destination for each onsite shipment, the projected waste volume, and the number of shipments. Alternative Group A also involves shipments of MLLW to offsite treatment facilities, including shipments of contact-handled inorganic solids and debris (waste stream 13B) to the Oak Ridge [Tennessee] Reservation (ORR) and back for thermal treatment and shipments of contact-handled inorganic solids and debris to a commercial treatment facility adjacent to the Hanford Site and back for non-thermal treatment (waste stream 13A).

Shipping data for Alternative Group B (see Table H.3) is similar to Group A except for ILAW and MLLW shipments. In Group B, the ILAW disposal facility is assumed to be located in the 200 West Area (it was assumed to be located near the PUREX Plant in Alternative Group A); consequently, the shipping distance for ILAW canisters is longer in Alternative Group B than in Alternative Group A. For MLLW, wastes that were assumed to be shipped offsite for thermal treatment are, instead, shipped to a new treatment facility assumed to be located in the 200 West Area. A small fraction of MLLW that was assumed to be shipped to the ORR for thermal treatment in Alternative Group A will continue to be shipped to ORR in Alternative Group B, but the majority is treated and disposed of onsite. This significantly reduces the shipping distances for these wastes in Alternative Group B.

Shipping data for Alternative Group C is similar to Alternative Group A, as the disposition of the wastes for both alternative groups are assumed to be located in the 200 West Area. Therefore, there would be only minimal differences in shipping data between the two alternative groups.

Similarly, MLLW is assumed to be disposed of in facilities located in the 200 East Area for Alternative Group C and Alternative Group A. Hence, there would be no differences in shipping data or impacts.

Table H.2. Shipping Data for Alternative Group A, Hanford Only Waste Volume

Onsite Shipments	Origin	Destination	Waste Volume, m^3	Number of Shipments[(a)]
		LLW		
WRAP				
1B–LLW Cat 1	300 Area	WRAP	3,326	443
2C–LLW Cat 3	300 Area	WRAP	1,462	1,643
T Plant Complex				
1B2–LLW Cat 1	WRAP	T Plant	274	37
2C2–LLW Cat 3	WRAP	T Plant	143	161
Offsite Commercial Facilities				
6–LLW (non-conforming)	CWC	Comm Treat	299	40
Repackage in HICs, In-Trench Grouting				
2A–LLW Cat 3 direct disposal	300 Area	200 W LLBG	35,372	39,744
2C1–LLW Cat 3 from WRAP	WRAP	200 W LLBG	1,318	1,481
2C2–LLW Cat 3 from T Plant	T Plant	200 W LLBG	214	240
200 W LLBG				
1A–LLW Cat 1 direct disposal	300 Area	200 W LLBG	66,522	8,870
1A–LLW Cat 1 from Stream 11	300 Area	200 W LLBG	158	21
1B1–LLW Cat 1 from WRAP	WRAP	200 W LLBG	3,034	405
1B2–LLW Cat 1 from T Plant	T Plant	200 W LLBG	411	55
6–LLW (non-conforming)	Comm Treat	200 W LLBG	598	80
		MLLW		
WRAP				
11–Wastes ready for disposal	300 Area	WRAP	187	55
13–Waste verification	CWC	WRAP	2,684	789
13–Post-verification	WRAP	CWC	2,684	789
MLLW determined to be LLW	WRAP	LLBG	18	5
13A–CH standard (non-thermal) verification	Comm Treat	WRAP	4,022	1,183
13B–CH standard (thermal) verification	ORR	WRAP	673	47
Modified T Plant Complex				
12–RH MLLW	300 Area	T Plant	2,904	3,263
Commercial Treatment Facilities				
13A–CH standard (non-thermal)	CWC	Comm Treat	20,108	5,914
13B–CH standard (thermal)	CWC	ORR	6,727	470
14–Elemental lead	CWC	Comm Treat	600	176
15–Elemental mercury	CWC	Comm Treat	21	6

Table H.2. (contd)

Onsite Shipments	Origin	Destination	Waste Volume, m^3	Number of Shipments[(a)]
MLLW Enhanced Trench Design				
11–Wastes ready for disposal	300 Area	200 E LLBG	26,682	7,848
11–From WRAP verification	WRAP	200 E LLBG	187	55
12–RH MLLW from Modified T Plant	T Plant	200 E LLBG	4,066	1,196
13A–CH standard (non-thermal)	Comm Treat	200 E LLBG	36,195	10,646
13B–CH standard (thermal)	ORR	200 E LLBG	6,054	423
13A–CH standard (non-thermal) - post-verification	WRAP	200 E LLBG	4,022	1,183
13B–CH standard – post-verification	WRAP	200 E LLBG	673	198
14–Elemental lead	Comm Treat	200 E LLBG	1,200	353
15–Elemental mercury	Comm Treat	200 E LLBG	312	92
22–WTP melters	200E Area	200 E Trench	6,825	39
TRU Wastes				
WRAP				
4–Retrievably stored drums in trenches	LLBG	WRAP	3,714	495
9–Newly generated and existing CH standard containers	300 Area	WRAP	27,597	3,680
T Plant Complex				
17–K Basin sludge	K Basin	T Plant	139	156
Modified T Plant Complex				
4–Retrievably stored drums in trenches	LLBG	Modified T Plant	7,125	950
5–RH TRU waste in caissons	Caissons (200W)	Modified T Plant	23	26
8–TRU commingled PCB waste	CWC	Modified T Plant	80	11
10A–Newly generated CH non-standard	300 Area	Modified T Plant	1,077	144
10B–Newly generated RH TRU waste	300 Area	Modified T Plant	2,153	2,419
LLBGs				
4–TRU drums assayed in trench as LLW	Not transported; remains in burial ground			
4–TRU assayed as LLW in T Plant/WRAP	T Plant/ WRAP	200 W LLBG	3,000	400
4–TRU assayed in T Plant as LLW	T Plant	200 E LLBG	169	23
9–Drums assayed in WRAP as LLW	WRAP	200 W LLBG	305	41
10A–TRU assayed in T Plant as CH LLW	Modified T Plant	200 W LLBG	215	29
10B–TRU assayed in T Plant as RH LLW	Modified T Plant	200 W LLBG	431	484
ILAW	WTP	200 E Disposal	211,000	97,235

(a) Due to rounding, the number of shipments may not match exactly the result of dividing the volume shipped by the shipment capacity. See Table H.1 for the shipping capacities for the various waste types.
CH = contact-handled.
RH = remote-handled.

Table H.3. Shipping Data for Alternative Group B, Hanford Only Waste Volume

Onsite Shipments	Origin	Destination	Waste Volume, m^3	Number of Shipments[(a)]
LLW				
WRAP				
1B–LLW Cat 1	300 Area	WRAP	3,326	443
2C–LLW Cat 3	300 Area	WRAP	1,462	1,643
T Plant Complex				
1B2–LLW Cat 1	WRAP	T Plant	274	37
2C2–LW Cat 3	WRAP	T Plant	143	161
Offsite Commercial Facilities				
6–LLW (non-conforming)	CWC	Comm Treat	299	40
Repackage in HICs, In-Trench Grouting				
2A–LLW Cat 3 direct disposal	300 Area	LLBG	35,372	39,744
2C1–LLW Cat 3 from WRAP	WRAP	LLBG	1,318	1,481
2C2–LLW Cat 3 from T Plant	T Plant	LLBG	214	240
LLBGs				
1A–LLW Cat 1 direct disposal	300 Area	LLBG	66,522	8,870
1A–LLW Cat 1 from Stream 11	300 Area	LLBG	158	21
1B1–LLW Cat 1 from WRAP	WRAP	LLBG	3,034	405
1B2–LLW Cat 1 from T Plant	T Plant	LLBG	411	55
6–LLW (non-conforming)	Comm Treat	LLBG	598	80
MLLW				
WRAP				
11–Wastes ready for disposal	300 Area	WRAP	187	55
13–Waste verification	CWC	WRAP	2,684	789
13–Post-verification	WRAP	CWC	2,684	789
MLLW determined to be LLW	WRAP	LLBG	176	52
13B–CH standard (thermal) verification	ORR	WRAP	36	3
New Waste Processing Facility				
12–RH MLLW	CWC	NWPF	2,904	3,263
13A, B–CH standard	CWC	NWPF	26,475	7,787
14–Elemental lead	CWC	NWPF	600	176
15–Elemental mercury	CWC	NWPF	21	6
Offsite Treatment Facility				
13B–CH standard (thermal)	CWC	ORR	360	25
MLLW Enhanced Trench Design				
11–Wastes ready for disposal	300 Area	200 E LLBG	26,682	7,848
11–From WRAP verification	WRAP	200 E LLBG	187	55
12–RH MLLW from NWPF	NWPF	200 E LLBG	4,066	1,196
13A,B–CH standard	NWPF	200 E LLBG	46,584	13,701

Table H.3. (contd)

Onsite Shipments	Origin	Destination	Waste Volume, m^3	Number of Shipments[(a)]
13B–CH standard (thermal)	ORR	200 E LLBG	324	23
14–Elemental lead	NWPF	200 E LLBG	1,200	353
15–Elemental mercury	NWPF	200 E LLBG	312	92
22–WTP melters	200E Area	200 E Trench	6,825	39
TRU Wastes				
WRAP				
4–Retrievably stored drums in trenches	LLBG	WRAP	3,714	495
9–Newly generated and existing CH standard containers	300 Area	WRAP	27,597	3,680
T Plant Complex				
17–K Basin sludge	K Basin	T Plant	139	156
New Waste Processing Facility				
4–Retrievably stored drums in trenches	LLBG	NWPF	7,125	950
5–RH TRU waste in caissons	Caissons (200W)	NWPF	23	26
8–TRU commingled PCB waste	CWC	NWPF	80	11
10A–Newly generated CH non-standard	300 Area	NWPF	1,077	144
10B–Newly generated RH TRU waste	300 Area	NWPF	2,153	2,419
LLBGs				
4–TRU drums assayed in trench as LLW	Not transported; remains in burial ground			
4–TRU assayed as LLW in NWPF/WRAP	NWPF/WRAP	200 W LLBG	3,000	400
4–TRU assayed in NWPF as LLW	NWPF	200 E LLBG	169	23
9–Drums assayed in WRAP as LLW	WRAP	200 W LLBG	305	41
10A–TRU assayed in NWPF as CH LLW	NWPF	200 W LLBG	215	29
10B–TRU assayed in NWPF as RH LLW	NWPF	200 W LLBG	431	484
ILAW	WTP	200 E Disposal	211,000	97,235

(a) Due to rounding, the number of shipments may not match exactly the result of dividing the volume shipped by the shipment capacity. See Table H.1 for the shipping capacities for the various waste types.
CH = contact-handled.
RH = remote-handled.
NWPF = new waste processing facility.
ORR = Oak Ridge Reservation.
WTP = Waste Treatment Plant.

Alternative Group A also forms the base for Alternative Groups D and E. The difference among the three alternative groups is the location of disposal facilities for LLW; Alternative Groups D and E assume the wastes will be located in or near the 200 East Area, Alternative Group A assumes the wastes will be located in the 200 West Area. Because most of these wastes were assumed to be transported from the 300 Area to the 200 Area disposal facilities to bound the impacts, the exact locations of the disposal facilities have little effect on the potential transportation impacts.

Shipping data for the No Action Alternative are presented in Table H.4. Key differences between the No Action Alternative and the action alternative groups are that many waste streams are stored rather than being treated and disposed of. The MLLW that was assumed to be shipped to ORR for treatment and back is assumed, instead, to be shipped to a commercial treatment facility adjacent to the Hanford Site. The No Action Alternative substantially reduces the amount of transportation required to manage solid wastes.

Table H.4. Onsite Shipping Data for the No Action Alternative

Onsite Shipments	Origin	Destination	Volume Shipped, m^3	Number of Shipments[(a)]
LLW				
WRAP				
1B–LLW Cat 1	300 Area	WRAP	3,326	443
2C–LW Cat 3	300 Area	WRAP	1,462	1,643
T Plant Complex				
1B2–LLW Cat 1	WRAP	T Plant	274	37
2C2–LLW Cat 3	WRAP	T Plant	143	161
Repackage in HICs or Trench Grouting				
2A–LLW Cat 3 direct disposal	300 Area	200 W LLBG	35,372	39,744
2C1–LLW Cat 3 from WRAP	WRAP	200 W LLBG	1,318	1,481
2C2–LLW Cat 3 from the T Plant Complex	T Plant	200 W LLBG	214	240
LLBGs				
1A–LLW Cat 1 direct disposal	300 Area	200 W LLBG	66,522	8,870
1A–LLW Cat 1 from Stream 11	300 Area	200 W LLBG	18	2
1B1–LLW Cat 1 from WRAP	WRAP	200 W LLBG	3,034	405
1B2–LLW Cat 1 from the T Plant Complex	T Plant	200 W LLBG	411	55
MLLW				
WRAP				
11–Wastes ready for disposal	300 Area	WRAP	205	60
13–Waste verification	CWC	WRAP	2,684	789
13–Offsite treatment verification	Comm Treat	WRAP	36	3
Commercial Treatment Facilities				
13B–CH standard (thermal)	CWC	Comm Treat	360	25
Central Waste Complex				
11–Wastes ready for indefinite storage	300 Area	CWC	18,123	5,330
12–RH and non-standard packages	300 Area	CWC	2,904	3,263
13A,B–CH solids and debris	300 Area	CWC	26,475	7,787
13–Post-WRAP verification	WRAP	CWC	2,684	789

Table H.4. (contd)

Onsite Shipments	Origin	Destination	Volume Shipped, m^3	Number of Shipments[(a)]
14–Elemental lead	300 Area	CWC	600	176
15–Elemental mercury	300 Area	CWC	21	6
22–WTP melters	WTP (200E)	CWC	6,825	39
200 E LLBG Existing Design Trenches				
11–Wastes ready for disposal	300 Area	200 E LLBG	26,682	7,848
11–Post-verification wastes from WRAP	WRAP	200 E LLBG	113	33
3B–CH standard (thermal) from WRAP verification	WRAP	200 E LLBG	36	11
13B–CH standard (thermal) from Comm Treat	Comm Treat	200 E LLBG	324	23
TRU Wastes				
WRAP				
4–Retrievably stored drums in trenches	200 E LLBG	WRAP	3,714	495
9–H - standard containers				
- 208-L (55-gal) drums	300 Area	WRAP	6,092	812
- Standard waste boxes	300 Area	WRAP	21,505	3,773
Storage at CWC or T Plant Complex				
4–TRU to indefinite storage	200 E LLBG	CWC	7,125	950
5–RH TRU waste in caissons	200 W LLBG	CWC	23	26
8–TRU commingled PCB waste	300 Area	CWC	80	11
10A–Newly generated CH non-standard	300 Area	CWC	1,077	144
10B–Newly generated RH waste	300 Area	CWC	2,157	2,424
17–K Basin sludge	K Basin	T Plant	139	156
LLBGs				
4–Drums assayed in WRAP as LLW	WRAP	200W LLBG	371	49
9–Drums assayed in WRAP as LLW	WRAP	200 W LLBG	305	41
ILAW	WTP	Vault	Intrafacility Transfer	

(a) Due to rounding, the number of shipments may not match exactly the result of dividing the volume shipped by the shipment capacity. See Table H.1 for the shipping capacities for the various waste types.
CH = contact-handled.
RH = remote-handled.
ORR = Oak Ridge Reservation.
WTP = Waste Treatment Plant.

To provide a conservative analysis, waste sent from Hanford for thermal treatment was assumed to go to the ORR. This is conservative because of the long shipping distance between Hanford and ORR. The analysis of the ORR shipments is discussed in the sections that address offsite shipments. The results are presented here for onsite shipments because the waste is Hanford-generated. Shipments to non-thermal treatment facilities were assumed to be transported to a commercial treatment facility adjacent to the Hanford Site.

H.2.2 Offsite Shipping Data

The volumes of the different waste types that might be shipped to Hanford from offsite and from Hanford to WIPP are presented in Appendix B. These data are summarized in Table H.5. The table includes Upper Bound and Lower Bound waste volume estimates. The Upper Bound waste volume includes all the TRU wastes that might be transported from small quantity sites to Hanford under a "western hub" scenario (DOE 2002d).

Table H.5. Offsite Shipment Volumes and Shipment Projections

Waste Type/Generator	Waste Volume, m^3		Number of Shipments	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
LLW				
Ames Laboratory (Ames, Iowa)	75	75	6	6
Argonne National Laboratory-East	11,366	11,366	795	795
Battelle Columbus Laboratory	774	774	55	55
Bettis Atomic Power Laboratory	549	549	39	39
Bettis Atomic Power Shipyards	1	1	1	1
Brookhaven National Laboratory	1,574	14,894	111	1,042
Energy Technology Engineering Center	1,428	1,521	100	107
Fermi National Accelerator Laboratory	1,627	1,627	114	114
General Electric Vallecitos	0	20	0	2
Grand Junction Projects Office	0	55	0	4
Idaho National Engineering and Environmental Laboratory	0	6,419	0	449
Inhalation Toxicology Research Institute	0	670	0	47
Knolls Atomic Power Shipyards	356	356	25	25
Lawrence Berkeley National Laboratory	174	174	13	13
Lawrence Livermore National Laboratory	0	10,975	0	768
MIT/Bates Linear Accelerator Center	11	11	1	1
Oak Ridge Reservation	0	78,883	0	5,517
Paducah Gaseous Diffusion Plant	46	46	4	4
Pantex Facility	0	1,205	0	85
Princeton Plasma Physics Laboratory	2,081	2,081	146	146
Rocky Flats Plant	0	65,033	0	4,548
Sandia National Laboratories	0	2,748	0	193
Separations Process Research Unit	0	8,220	0	575
Stanford Linear Accelerator	756	756	53	53
West Valley Nuclear Services	0	11,297	0	790
Total LLW	20,818	219,756	1,463	15,379
MLLW				
Battelle Columbus Laboratory	0.3	0.3	1	1
Energy Technology Engineering Center	0	1,365	0	96

Table H.5. (contd)

Waste Type/Generator	Waste Volume, m³		Number of Shipments	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Idaho National Engineering and Environmental Laboratory	0	196	0	14
Knolls Atomic Power Laboratory	6	6	1	1
Los Alamos National Laboratory	0	3,373	0	236
Oak Ridge Reservation	0	55,323	0	3,869
Paducah Gaseous Diffusion Plant	0	2,681	0	188
Portsmouth Gaseous Diffusion Plant	0	2,933	0	206
Princeton Plasma Physics Laboratory	91	91	7	7
Puget Sound Naval Shipyards	3	3	1	1
Rocky Flats Plant	0	68,146	0	4,766
Sandia National Laboratory	0	160	0	12
Savannah River Site	0	6,134	0	429
West Valley Nuclear Services	0	26	0	2
Total MLLW	101	140,438	10	9,828
CH TRU Waste[(a)]				
Battelle Columbus Laboratories[(c)]	2	2	1	1
Energy Technology Engineering Center[(c)]	4	4	1	1
General Electric-Vallecitos Nuclear Center.	0	28	0	4
Lawrence Berkeley National Laboratory	0	3	0	1
Lawrence Livermore National Laboratory	0	1,237	0	165
Nevada Test Site	0	182	0	25
Total CH TRU Waste	6	1,456	2	197
RH TRU Waste[(a)]				
Battelle Columbus Laboratories[(c)]	25	25	29	29
Energy Technology Engineering Center[(c)]	15	15	17	17
Framatome ANP	0	9	0	10
General Electric Vallecitos Nuclear Center	0	50	0	57
Total RH TRU Waste	40	99	46	113
Shipments from Hanford to WIPP[(b)]				
CH TRU waste to WIPP	39,157	40,607	5,221	5,415
RH TRU waste to WIPP	2,657	2,716	2,986	3,052
Total TRU Wastes to WIPP	41,814	43,323	8,207	8,467

(a) These projections do not include additional TRU waste volumes at the West Valley Demonstration Project that could be shipped to Hanford under a non-preferred alternative (DOE 2003). The potential impacts of these shipments are provided in Section H.3.3.2.2. See Section C.1 for additional information about waste volumes.
(b) Under the No Action Alternative for the Hanford Only waste volume, 31,207 m^3 of CH TRU waste (4,161 shipments) are projected to be shipped from Hanford to WIPP. Under the action alternatives for the Hanford Only waste volume, 39,151 m^3 of CH TRU waste and 2,617 m^3 of RH TRU waste (5,221 and 2,941 shipments, respectively) are projected to be shipped from Hanford to WIPP. The Upper and Lower Bound waste volumes include these wastes plus the TRU wastes from offsite, as listed above.
(c) At the present time, Hanford has received all of the TRU waste from ETEC and about one-sixth of the TRU waste from the Battelle Columbus Laboratories.

A third and fourth case also were analyzed. The third case involves shipment of the Hanford Only waste volume of TRU waste to WIPP under the No Action Alternative. There are no other offsite shipments in the No Action Alternative. In the No Action Alternative, a total of 31,200 m^3 of CH TRU waste is assumed to be shipped to WIPP. This would require about 4,200 shipments. In the No Action Alternative, no RH TRU waste would be transported from Hanford to WIPP (that is, RH TRU waste is assumed to be stored onsite for an indefinite period of time). The fourth case involves shipment of the Hanford Only waste volume of TRU waste to WIPP under the action alternative groups. In this case, a total of about 39,000 m^3 of CH TRU waste and 2,600 m^3 of RH TRU waste are assumed to be shipped from Hanford to WIPP. This represents about 5,200 shipments of CH TRU waste and 2,900 shipments of RH TRU waste. Table H.6 presents the shipment capacities that were used to calculate the numbers of shipments presented in Table H.5.

Table H.6. Shipping Capacities Used to Estimate Offsite Shipments

Waste Type	Shipping Capacity, m^3	Basis
LLW	14.3	WM PEIS;[(a)] equivalent to 80 drums per shipment.
MLLW	14.3	WM PEIS;[(a)] same as LLW.
CH TRU waste	7.5	Equivalent to 42 drums/shipment at 85% packing efficiency.
RH TRU waste	0.89	WIPP SEIS-II.[(b)]

(a) Source: DOE (1997a).
(b) Source: DOE (1997b).

The TRAGIS computer code was used to develop the route characteristics information used in the impact analyses. The data developed by TRAGIS includes the distances traveled in rural, suburban, and urban population density regions. These analyses used actual highway routes to and from Hanford. Population data are based on the 2000 Census. These data are used in various calculations performed by RADTRAN 5. The route characteristics for shipments from offsite to Hanford and from Hanford to WIPP that are used in this impact analysis are presented in Table H.7. Figure H.1 illustrates the routes used in this analysis.

Table H.7. Route Characteristics Data for Offsite Shipments

Offsite Generator	One-Way Distance (km)	Distance by Zone			Population Densities, per km^2		
		Rural	Suburban	Urban	Rural	Suburban	Urban
Ames Laboratory (Ames, Iowa)	2769	2393.8	340.6	34.8	9.1	289.5	2280.9
Argonne National Laboratory-East	3240.1	2770.5	432.8	37.1	9.8	289	2263.3
Battelle Columbus Laboratory	3751.8	3087.3	611.4	53.5	10.6	296.8	2217.4
Bettis Atomic Power Laboratory	3996.6	3162.2	759.6	75	11	300.3	2268.6
Bettis Atomic Power Shipyards	3996.6	3162.2	759.6	75	11	300.3	2268.6
Brookhaven National Laboratory	4659.7	3534.9	982.7	142.5	11.5	320	2531.7
Energy Technology Engineering Center	1959.4	1437.1	424.6	97.7	11.2	355	2455.7
Fermi National Accelerator Laboratory	3225.2	2766.6	425.1	33.7	9.7	285.2	2200.9
General Electric Vallecitos	1455.4	979.9	385	90.3	11.8	372.5	2402.9
Grand Junction Project Office	1525.5	1216.3	257.8	51.6	8.4	349.4	2402.6
Idaho National Engineering and Environmental Laboratory	875.1	762.3	99.2	13.7	7.5	325.4	2180.3
Inhalation Toxicology Research Institute	2036.7	1665.3	311.6	60.1	7.7	347.4	2410.5
Knolls Atomic Power Shipyards	4556.3	3472.5	989.5	94.6	11.6	304.2	2266.6
Los Alamos National Laboratory	2548.7	2132.8	361	54.8	8	337.6	2304.3
Lawrence Berkeley National Laboratory	1422.9	969.2	362.6	90.9	11.7	369	2529.6
Lawrence Livermore National Laboratory	1463.2	986.3	385.1	91.7	11.7	374.3	2406.7
MIT/Bates Linear Accelerator Center	4818.7	3613.7	1092.3	112.9	11.8	308.8	2409.8
Nevada Test Site	1842.1	1496.7	286.2	59.6	8.8	339.0	2407.9
Oak Ridge Reservation	4038.9	3264.5	710.7	63.8	10.9	298.1	2201
Paducah Gaseous Diffusion Plant	3583.6	2960.9	567.2	55.6	10.0	306.9	2174.0
Portsmouth Gaseous Diffusion Plant	3817.5	3072.5	663.5	81.9	10.3	325	2242.5
Pantex Facility	2573.7	2171.1	349.3	53.4	7.4	350.7	2285.8
Princeton Plasma Physics Laboratory	4597.8	3545.3	955.3	97.4	11.6	310	2284.6
Puget Sound Naval Shipyard	485.9	290.3	159.2	36.5	10.4	369.7	2308.5
Rocky Flats Plant	2046.7	1671.3	312.2	63.5	7.7	349	2402.4
Sandia National Laboratories	2046.7	1671.3	312.2	63.5	7.7	349	2402.9
Savannah River Site	4460.4	3429	928	103.5	11.2	320.7	2240.4
Separations Process Research Unit	4556.3	3472.5	989.5	94.6	11.6	304.2	2266.6
Stanford Linear Accelerator	1522.1	987.3	405.9	128.5	11.9	382.6	2637
West Valley Nuclear Services	4133.2	3253.7	804.6	75.2	11.3	291.9	2268.1
Hanford to WIPP	3137.8	2671.7	399.3	66.8	7.2	340	2301.1

Figure H.1. Routes from Offsite to Hanford and from Hanford to WIPP

H.2.3 Accident Risk Input Data

This section provides the key input parameters used in the RADTRAN 5 analysis of transportation accident risks. These parameters include the severity category fractions, release fractions, and radionuclide concentrations in shipments of solid waste.

Table H.8 shows the accident parameters used in this analysis of onsite shipments in Type A 208-L (55-gal) drums and boxes as well as ILAW canisters. Note that the release fractions used are very conservative for the vitrified waste form, which would be transported in shipping containers that are much less likely to fail in accident conditions than a drum or box shipment. For offsite shipments of CH TRU waste, the analysis assumes the TRUPACT-II container would be used. The accident scenarios assume a truck shipment would contain three TRUPACT-II containers but that only one TRUPACT-II would fail in a severe accident and the remaining two TRUPACT-II containers would not. This is consistent with the assumption made in WIPP SEIS-II (DOE 1997b), and is based on an evaluation conducted by Fischer et al. (1987) in which it was concluded that the release fraction from an engulfing fire that fails three TRUPACT-IIs is lower than the impact release fraction from a single failed TRUPACT-II. For offsite shipments of RH TRU waste, the analysis assumes that the RH 72B package would be used. Offsite shipments of LLW and MLLW were assumed to be shipped in Type A packages, even though the radionuclide inventories used in this analysis may exceed Type A packaging limits. This was done to ensure that the radiological accident risk analysis would bound the range of potential impacts. Based on historical experience, offsite LLW and MLLW shipments are predominantly shipped in Type A packages.

Accident rates for offsite shipments were calculated using state-specific data from Saricks and Tompkins (1999) and the outputs from the TRAGIS calculations. Weighted average traffic accident and fatality rates were calculated for each route by combining the distances traveled along each route on interstates and primary highways with the rates given by Saricks and Tompkins (1999) for these types of highways. The overall rate was calculated by summing across all the states along a specific route between offsite and Hanford and between Hanford and WIPP.

Concentrations of radioactive materials that were used to calculate the per-shipment inventories of each radionuclide, taken from the Technical Information Document (FH 2004), are shown in Table H.9. Table H.10 presents similar information for offsite shipments. Hazardous chemical source inventories for each material shipped were taken from the Technical Information Document (FH 2004) and are shown in Table H.11. A “maximum drum” approach was used to develop the inventories by taking the highest concentrations of each radionuclide for each waste type. Consequently, the inventories may exceed Type A packaging limitations. The actual shipments would be conducted in compliance with the packaging requirements. Where necessary, adjustments were made to the 208-L (55-gal) drum inventories to account for different waste container sizes and shipment capacities. Note that only a few streams are presented in Tables H.9 through H.11. Readers are referred to FH (2004) for information on other waste streams.

Table H.8. RADTRAN 5 Accident Parameters for Onsite Truck Shipments

Accident Rate Onsite[(a)] – Hanford Sitewide Average – 1.14E-07 Accidents per Mile			
Fractional Occurrence by Severity Category (Conditional Probability Given an Accident Occurs)[(b)]			
Severity Category			
I	5.5E-01		
II	3.6E-01		
III	7E-02		
IV	1.6E-02		
V	2.8E-03		
VI	1.1E-03		
VII	8.5E-05		
VIII	1.5E-05		
Fractional Occurrence by Population Zone (Conditional Probability Given an Accident Occurs of the Specified Severity)[(b)]			
Severity Category	**Rural**	**Suburban**	**Urban**
I	0.1	0.1	0.8
II	0.1	0.1	0.8
III	0.3	0.4	0.3
IV	0.3	0.4	0.3
V	0.5	0.3	0.3
VI	0.7	0.2	0.1
VII	0.8	0.1	0.1
VIII	0.9	0.05	0.05
Release Fraction (Fraction of Container Contents Released from Shipment by Severity Category)[(b)]			
Severity Category	**Type A Package (e.g., Cat 1 LLW)**		**Type B Package (e.g., CH TRU waste)**
I	0		0
II	0.01		0
III	0.1		0.01
IV	1		0.1
V	1		1
VI	1		1
VII	1		1
VIII	1		1

Table H.8. (contd)

Accident Rate **Onsite[(a)] – Hanford Sitewide Average – 1.14E-07 Accidents per Mile**	
Aerosol and Respirable Fractions	
LLW and MLLW	Volatiles–Aerosol and Respirable Fractions = 1 and 1, respectively Solids (Powders) –Aerosol Fraction = 0.1; Respirable Fraction = 0.05
CH TRU waste (DOE 1997a)	Categories I and II–Total Respirable Release Fraction: 0.0 Category III–8E-09; Category IV–2E-07; Category V–8E-05 Category VI–2E-04; Category VII–2E-04; Category VIII–2E-04
RH TRU waste (DOE 1997a)	Categories I and II–Total Respirable Release Fraction: 0.0 Category III–6E-09; Category IV–2E-07; Category V–1E-04 Category VI–1E-04; Category VII–2E-04; Category VIII–2E-04
ILAW	Categories I and II–Total Respirable Release Fraction: 0.0 Category III–8E-09; Category IV–2E-07; Category V–8E-05 Category VI–2E-04; Category VII–2E-04; Category VIII–2E-04
Miscellaneous Parameters	
Deposition velocity (DOE 2002a)	0.01 m/sec
Resuspension half-life (DOE 1997b)	365 days

(a) Source: Green et al. (1996).
(b) Data taken from NUREG-0170 (NRC 1977) except where otherwise indicated. See text box in Section H.2 for definitions of Type A and Type B packages.

Table H.9. Radionuclide Concentrations (Ci/m^3) Used to Calculate Per-Shipment Inventories[(a)] for Onsite Shipments

Radionuclide	Cat 1 LLW (CH)	Cat 3 LLW (RH)	CH MLLW	RH MLLW	ILAW	CH TRU Waste[(b)]	RH TRU Waste[(b)]
Am-241	2.6E-03	3.1E-05	0	0	1.1E-01	3.6	12
C-14	4.3E-06	7.7E-05	0	0	< 0.1%	0	0
Cm-244	3.3E-04	5.6E-04	0	0	1.1E-03	0	0
Co-60	1.8E-02	6.3E-01	3.1E-01	2.8E-01	< 0.1%	6.4E-04	2.5
Cs-137–Ba-137m	3.3	3.5E-03	7.4	6.6	< 0.1%	0.01	49
Fe-55	1.7E-02	1.1E-01	2.8	2.5	< 0.1%	0	0
H-3	5.4E-04	3.3E-03	3.9E-03	3.5E-03	< 0.1%	0	0
Mn-54	2.6E-03	3.4E-04	9.6E-05	8.6E-05	< 0.1%	0	0
Ni-59	3.0E-06	1.0E-02	0	0	< 0.1%	0	0
Ni-63	2.9E-02	1.2E	2.0E-01	1.8E-01	< 0.1%	0	0
Pu-238	6.6E-04	2.9E-04	0	0	1.1E-03	990	1000
Pu-239	3.1E-03	1.2E-04	0	0	3.2E-02	16	20
Pu-240	1.2E-03	2.1E-05	0	0	5.5E-03	4.2	10
Pu-241	7.4E-02	7.4E-04	0	0	1.1E-01	200	10
Pu-242	5.7E-07	2.1E-09	0	0	< 0.1%	6.8E-04	0
Sr-90–Y90	4.1	1.0E-02	2.5	2.2	4.7E+01	0.01	49
Tc-99	3.2E-03	4.4E-04	3.5E-02	3.1E-02	< 0.1%	0	0
U-233	2.9E-06	2.4E-07	0	0	1.4E-03	0	0.03
U-234	3.6E-03	2.9E-04	0	0	4.6E-04	0	0
U-235	1.0E-04	4.6E-06	0	0	< 0.1%	0	1.0E-03
U-236	4.6E-04	5.4E-06	0	0	< 0.1%	0	0
U-238	5.8E-03	7.1E-05	0	0	5.1E-04	0	7.1E-05
Note: ILAW inventory also includes the following:							
Np-237	NA	NA	NA	NA	8.5E-04	NA	NA
Sm-151	NA	NA	NA	NA	8.2	NA	NA
Cd-113m	NA	NA	NA	NA	8.4E-02	NA	NA
Eu-154	NA	NA	NA	NA	4.0E-01	NA	NA
Ra-226	NA	NA	NA	NA	1.1E-02	NA	NA

(a) Source: FH (2004).
(b) Source: DOE (1997a). Units are Ci per shipment.
NA = not applicable.

Table H.10. Radionuclide Inventories (Ci per shipment) for Offsite Shipments

LLW												
Radionuclide	**BNL**	**GE**	**INEEL**	**ITRI**	**LLNL**	**ORR**	**PNTX**	**RFTS**	**SNL**	**SPRU**	**WVDP**	**MAX DRUM[(b)]**
H-3	2.1E-03	0	2.5E+03	1.4E-01	5.7E-02	3.1E+02	1.5E-02	1.3E-03	4.1E+01	5.2E-03	4.1E+01	2.5E+03
C-14	0	0	2.0E-01	5.8E-02	3.4E-05	3.6E-03	0	0	3.4E-02	1.1E-09	3.4E-02	2.0E-01
Co-60	7.4E-05	2.0E-02	6.9E+03	0	0	2.7	0	0	7.8E+01	5.9E-03	8.1E+01	6.9E+03
Ni-59	0	0	3.8E+01	0	0	1.2E-05	0	0	4.0E-01	7.5E-06	3.9E-01	3.8E+01
Ni-63	0	0	1.3E+03	0	0	4.9E+01	0	0	1.8E+01	3.3E-04	1.8E+01	1.3E+03
Sr-90	1.8E-02	1.0E-01	9.8E-01	0	0	2.0E-01	0	2.4E-09	2.1E+01	3.7E-02	2.2E+01	2.2E+01
Y-90	1.8E-02	1.0E-01	9.8E-01	0	0	2.0E-01	0	2.4E-09	2.1E+01	3.7E-02	2.2E+01	2.2E+01
Tc-99	0	0	1.2E-03	0	0	2.2E-05	0	0	3.5E-03	8.2E-08	3.5E-03	3.5E-03
Cs-137	2.9E-02	7.1E-02	1.9E+01	0	0	1.8E+01	0	8.8E-07	1.4E+01	5.7E-02	1.4E+01	1.9E+01
Ba-137m	2.8E-02	6.7E-02	1.8E+01	0	0	1.7E+01	0	8.4E-07	1.4E+01	5.4E-02	1.4E+01	1.8E+01
U-234	3.9E-06	0	2.7E-04	0	0	1.4E-02	1.9E-04	1.6E-05	1.2E-02	3.1E-04	1.2E-02	1.4E-02
U-235	1.4E-06	0	3.8E-03	0	0	6.2E-04	3.3E-05	4.8E-09	6.2E-04	1.4E-05	6.1E-04	3.8E-03
U-238	3.1E-06	0	1.6E-01	1.2E-02	9.8E-03	6.7E-03	2.0E-03	1.4E-05	2.8E-02	9.9E-04	2.8E-02	1.6E-01
MLLW												
	ETEC	**INEEL**	**LANL**	**ORR**	**PGDP**	**PORT**	**RFTS**	**SNL**	**SRS**	**WVDP**	**MAX DRUM[(b)]**	
H-3	0	2.4E+03	0	3.6E-03	0	0	2.1E-02	6.6	2.1E+03	2.1E-09	2.4E+03	
C-14	0	2.0E-01	0	0	0	0	0	0	1.4E-011	0	2.0E-01	
Co-60	0	6.9E+03	0	2.4E-06	3.8E-05	0	0	3.7E-05	1.7	0	6.9E+03	
Ni-59	0	3.7E+01	0	0	0	0	0	0	2.8E-010	0	3.7E+01	
Ni-63	0	1.3E+03	0	0	0	0	0	4.0E-01	0	0	1.3E+03	
Sr-90	1.8E-05	9.5E-01	0	1.2E-05	0	0	2.9E-09	0	1.0E-04	0	9.5E-01	
Y-90	1.8E-05	9.5E-01	0	1.2E-05	0	0	2.9E-09	0	1.0E-04	0	9.5E-01	
Tc-99	0	1.2E-03	0	9.0E-02	6.9E-02	7.3E-04	0	0	8.6E-05	0	9.0E-02	
Cs-137	6.2E-06	1.9E+01	0	1.3E-04	1.1E-04	0	1.0E-06	2.2E-03	4.9	2.8E-05	1.9E+01	
Ba-137m	5.9E-06	1.8E+01	0	1.2E-04	1.0E-04	0	1.0E-06	2.1E-03	4.7	2.6E-05	1.8E+01	
U-234	0	2.6E-04	1.1E-05	7.2E-04	3.4	0	1.1E-03	0	2.3E-02	0	3.4	
U-235	0	3.7E-03	5.1E-07	1.0E-05	1.5E-01	2.3E-06	9.4E-05	6.1E-05	1.1E-03	0	1.5E-01	
U-238	0	1.6E-01	1.1E-05	9.0E-03	3.3	9.8E-03	1.1E-03	8.6E-03	5.6E-02	0	3.3	

Table H.10. (contd)

TRU Wastes

	CH TRU Waste Ci per TRUPACT[c]	RH TRU Waste Ci per RH 72[c]
Co-60	6.4E-04	2.50
Sr-90	1.0E-02	4.9E+01
Cs-137	1.0E-02	4.9E+01
U-233	0	3.0E-02
U-235	0	1.0E-03
U-238	0	7.1E-05
Pu-238	9.9E+02	1.0E+03
Pu-239	1.6E+01	2.0E+01
Pu-240	4.2	1.0E+01
Am-241	3.6	1.2E+01
Pu-241	2.0E+02	1.0E+01
Pu-242	6.8E-04	0

BNL = Brookhaven National Laboratory
ETEC = Energy Technology Engineering Center
GE = General Electric Vallecitos
INEEL = Idaho National Engineering and Environmental Laboratory
ITRI = Inhalation Toxicology Research Institute
LANL = Los Alamos National Laboratory
LLNL = Lawrence Livermore National Laboratory
ORR = Oak Ridge Reservation
PGDP = Paducah Gaseous Diffusion Plant
PORT = Portsmouth Gaseous Diffusion Plant
PNTX = Pantex Plant
RFTS = Rocky Flats Technology Site
SNL = Sandia National Laboratory
SPRU = Separations Process Research Unit
SRS = Savannah River Site
WVDP = West Valley Demonstration Project

(a) Source: FH (2004) except where otherwise indicated.
(b) MAX DRUM = Maximum drum. This inventory is used for shipments from offsite other than those listed here.
(c) Source: Bounding case radionuclide inventories given in DOE (1997b).

Table H.11. Hazardous Chemical Inventories in Various Waste Types[(a)]

Hazardous Chemical	Hazardous Chemical Inventories (kg per 208-L [55-gal] Drum)							
	CH MLLW	RH MLLW	MLLW Ready for Disposal	RH TRU Waste	CH TRU with PCBs	RH TRU Waste in Trenches	Elemental Lead	Elemental Mercury
Acetone	3.7E-02	3.6E-02	3.7E-02	1.4E-04	0	0	0	0
Beryllium	9.5E-01	9.5E-01	9.5E-01	8.9E-02	8.9E-02	8.9E-02	0	0
Bromodichloro-methane	2.1E-04	0	2.1E-04	0	0	0	0	0
Carbon tetrachloride	7.5E-02	0	7.5E-02	2.4E-02	0	0	0	0
Diesel fuel	2.8E-02	0	2.8E-02	0	0	0	0	0
Formic acid	1.7E-01	0	1.7E-01	0	0	0	0	0
Lead	0	0	0	0	0	0	1.7E+02	0
Methyl ethyl ketone (MEK or 2-Butanone)	2.9E-02	0	2.9E-02	0	0	0	0	0
Mercury	8.8E-03	0	8.8E-03	8.6E-04	0	0	0	2.4E+01
Nitrate	4.1E-02	0	0	0	0	0	0	0
Nitric acid	1.2	1.2	1.2	0	0	0	0	0
Polychlorinated biphenyls (PCBs)[(b)]	1.0E-01	0	1.0E-01	0	3.2E-01	0	0	0
p-Chloroaniline	9.9E-02	0	9.9E-02	0	0	0	0	0
Sodium hydroxide	1.7	1.7	1.7	8.9E-02	8.9E-02	8.9E-02	0	0
Toluene	6.2E-02	1.9	6.2E-02	0	0	0	0	0
1,1,1-Trichloroethane	1.3E-01	0	1.3E-01	1.4E-04	0	0	0	0
Xylene	1.1E-02	1.8E-01	1.1E-02	7.2E-04	8.6E-01	8.6E-01	0	0

Note: 0 indicates no data was provided in the source document.

(a) Source: FH (2004). Hazardous chemical quantities were calculated assuming they are packaged in a 208-L (55-gal) drum at 85% packaging efficiency (i.e., 15% void space) or 0.18 m^3 of waste per drum.

(b) PCB's come in many forms (for example, Aroclor 1016, Arochor 1221). The actual chemical form of the PCB contaminants in solid waste is uncertain. Therefore, for conservatism, PCBs were assumed to be in the chemical form that presents the greatest hazard (that is, lowest exposure guidelines concentrations.

H.3 Results of Transportation Impact Analysis

The results of the transportation impact analysis are presented in this section. Section H.3.1 presents the onsite impact analysis results and Section H.3.2 presents the offsite impacts. Both sections present the aggregate radiological and non-radiological transportation impacts. Section H.3.2 also presents the results of the analysis of maximally exposed individuals under incident-free and accident conditions. Section H.3.3 presents a summary of the transportation impact analysis results and the results of two sensitivity studies.

H.3.1 Results of Onsite Transportation Impact Analysis

This section presents the results of the onsite transportation impact analysis. Separate subsections are presented for results of Alternative Groups A through E and the No Action Alternative. The accident impact analysis results for hazardous chemicals are presented in Section H.6. All of the impacts provided in the table are in fatalities except for the estimated number of traffic accidents. Fatalities are expressed as latent cancer fatalities (LCFs) for radiological impacts and for incident-free non-radiological emissions. For non-radiological accidents, impacts are expressed in terms of the predicted number of traffic accidents and fatalities from physical trauma resulting from those traffic accidents. Note that many of the entries in the table are expressed as fractional fatalities, for example, 1E-01 or 0.1 fatalities. The whole-number totals are determined by summing over all waste types and then rounding the sums to the nearest whole number.

H.3.1.1 Alternative Group A

The transportation impacts for Alternative Group A, Hanford Only waste volume, are presented in Table H.12. The table includes the impacts of onsite shipments of LLW, MLLW, TRU wastes, and ILAW in addition to shipments of the small volumes of Hanford LLW and MLLW to offsite treatment facilities and back. The impacts of shipments from offsite, which make up all the differences among the Hanford Only, Lower Bound, and Upper Bound waste volumes, are addressed in Section H.3.2.

H.3.1.2 Alternative Group B

Table H.13 presents the transportation impacts for Alternative Group B, Hanford Only waste volume. The table includes the impacts of transporting LLW, MLLW, TRU wastes, and ILAW onsite in addition to the impacts of transporting the small volumes of Hanford LLW and MLLW to offsite treatment facilities and back. Most MLLW and the non-conforming LLW would be treated onsite, so smaller volumes are shipped to offsite treatment facilities and back in this alternative than in Alternative Group A. Note that the shipping parameters and estimated impacts for onsite transportation of LLW and TRU wastes are the same in this alternative group as they are in Alternative Group A. ILAW transportation impacts are larger in Alternative Group B than in Alternative Group A because the shipping distance is longer. A smaller volume of MLLW is transported offsite for treatment and back in Alternative Group B than in Alternative Group A. Also note that the impacts of shipments from offsite, which make up all the differences among the Hanford Only, Lower Bound, and Upper Bound waste volumes, are addressed in Section H.3.2.

H.3.1.3 Alternative Group C

The results of the onsite transportation impact analysis for transport of solid waste under Alternative Group C are the same as those for Alternative Group A because there are no substantial differences in shipping parameters. This includes the onsite shipments of LLW, MLLW, TRU wastes, and ILAW as well as the small volumes of LLW and MLLW shipped to offsite treatment facilities and back. The small volumes of LLW and MLLW shipped offsite and back in this alternative are the same as those in Alternative Group A. Treatment and disposal facilities are located in the same areas of the Hanford Site in both alternative groups. Since most of these wastes were assumed to be transported from the 300 Area to 200 Area disposal facilities to bound the impacts, the exact locations of the disposal facilities have little effect on the potential transportation impacts.

H.3.1.4 Alternative Group D

The results of the onsite impact analysis for transport of solid waste under the Alternative Group D are the same as those for Alternative Group A because there are no substantial differences in shipping parameters. This includes the onsite shipments of LLW, MLLW, TRU wastes, and ILAW as well as the small volumes of LLW and MLLW shipped to offsite treatment facilities and back. The small volumes of LLW and MLLW shipped offsite and back in this alternative are the same as those in Alternative Group A.

H.3.1.5 Alternative Group E

The results of the impact analysis for transport of solid waste under Alternative Group E are the same as those for Alternative Group A because there are no substantial differences in shipping parameters. This includes the onsite shipments of LLW, MLLW, TRU wastes, and ILAW as well as the small volumes of LLW and MLLW shipped to offsite treatment facilities and back. The small volumes of LLW and MLLW shipped offsite and back in this alternative are the same as those in Alternative Group A.

H.3.1.6 No Action Alternative

Table H.14 presents the transportation impacts of the No Action Alternative. The table includes the impacts of transporting LLW, MLLW, and TRU wastes onsite plus the small volume of MLLW transported to offsite treatment facilities and back. In this alternative, a small volume of MLLW covered by existing contracts would be shipped offsite for treatment and back, and a small volume would also be treated onsite. Most MLLW and the non-conforming LLW would remain in storage at Hanford and would not be treated. There are no shipments of ILAW in this alternative because ILAW would be placed in concrete vaults adjacent to the WTP and thus is assumed not to involve transportation.

Table H.12. Transportation Impacts of Alternative Group A – Hanford Only Waste Volume, Number of Fatalities[(a)]

Onsite Shipments	Radiological Impacts, LCFs			Total Number of Accidents	Non-Radiological Impacts	
	Incident-Free Transport		Accidents			
	Workers	Public	Public		Number of Fatalities	Emissions LCFs
LLW						
WRAP						
1B–LLW Cat 1	5.6E-05	3.3E-04	1.6E-10	6.2E-03	2.7E-04	2.4E-04
2C–LLW Cat 3	1.8E-04	1.2E-03	1.2E-07	2.3E-02	9.9E-04	8.8E-04
T Plant Complex						
1B2–LLW Cat 1	1.5E-07	2.3E-06	6.2E-13	2.0E-05	8.8E-07	2.0E-06
2C2–LLW Cat 3	6.8E-07	1.0E-05	5.4E-10	9.0E-05	3.9E-06	8.7E-06
Offsite Commercial Facilities						
6–LLW (non-conforming)	5.0E-06	3.0E-05	1.5E-11	5.6E-04	2.4E-05	2.1E-05
Repackage in HICs, In-Trench Grouting						
2A–LLW Cat 3 direct disposal	4.3E-03	2.9E-02	2.9E-06	5.6E-01	2.4E-02	2.1E-02
2C1–LLW Cat 3 from WRAP	6.3E-06	9.2E-05	5.0E-09	8.3E-04	3.6E-05	8.0E-05
2C2–LLW Cat 3 from T Plant	1.0E-06	1.5E-05	8.1E-10	1.3E-04	5.8E-06	1.3E-05
200 W LLBG						
1A–LLW Cat 1 direct disposal	1.1E-03	6.7E-03	3.2E-09	1.2E-01	5.3E-03	4.8E-03
1A–LLW Cat 1 from Stream 11	2.6E-06	1.6E-05	7.7E-12	2.9E-04	1.3E-05	1.1E-05
1B1–LLW Cat 1 from WRAP	1.7E-06	2.5E-05	6.9E-12	2.3E-04	9.7E-06	2.2E-05
1B2–LLW Cat 1 from T Plant	2.3E-07	3.4E-06	9.3E-13	3.1E-05	1.3E-06	3.0E-06
6–LLW (non-conforming)	1.0E-05	6.0E-05	2.9E-11	1.1E-03	4.8E-05	4.3E-05
Total LLW	5.7E-03	3.8E-02	3.0E-06	7.1E-01	3.1E-02	2.8E-02
MLLW						
WRAP						
11–Wastes ready for disposal	6.0E-06	4.1E-05	1.5E-10	7.7E-04	3.3E-05	3.0E-05
13–Waste verification	3.3E-06	4.9E-05	1.0E-10	4.4E-04	1.9E-05	4.3E-05
13–Post verification	3.3E-06	4.9E-05	1.0E-10	4.4E-04	1.9E-05	4.3E-05
MLLW determined to be LLW	2.2E-08	3.3E-07	6.9E-13	3.0E-06	1.3E-07	2.9E-07
13A–CH standard (non-thermal) verification	1.3E-04	8.7E-04	3.3E-09	1.7E-02	7.1E-04	6.4E-04
13B - CH Standard (thermal) verification	1.0E-03	4.2E-03	1.2E-07	6.7E-02	1.5E-03	6.7E-03

Table H.12. (contd)

Onsite Shipments	Radiological Impacts, LCFs: Incident-Free Transport: Workers	Radiological Impacts, LCFs: Incident-Free Transport: Public	Radiological Impacts, LCFs: Accidents: Public	Total Number of Accidents	Non-Radiological Impacts: Number of Fatalities	Non-Radiological Impacts: Emissions LCFs
Modified T Plant						
12–RH MLLW	3.5E-04	2.4E-03	2.2E-08	4.6E-02	2.0E-03	1.8E-04
Commercial Treatment Facilities						
13A–CH standard (non-thermal)	6.4E-04	4.4E-03	4.0E-08	8.3E-02	3.5E-03	3.2E-03
13B–CH standard (thermal)	1.0E-02	4.2E-02	1.2E-06	6.6E-01	1.5E-02	6.7E-02
14–Elemental lead	0	0	0	2.5E-03	1.1E-04	9.5E-05
15–Elemental mercury	0	0	0	8.6E-05	3.7E-06	3.3E-06
MLLW Enhanced Trench Design						
11–Wastes ready for disposal	8.5E-04	5.8E-03	5.3E-08	1.1E-01	4.7E-03	4.2E-03
11–From WRAP verification	2.3E-06	3.4E-05	1.7E-10	3.1E-04	1.3E-05	3.0E-05
12–RH MLLW from Modified T Plant	5.1E-05	7.4E-04	3.8E-09	6.7E-03	2.9E-04	6.4E-04
13A–CH standard (non-thermal)	1.2E-03	7.9E-03	7.2E-08	1.5E-01	6.4E-03	5.7E-03
13B–CH standard (thermal)	9.4E-03	3.8E-02	1.0E-06	5.9E-01	1.3E-02	6.1E-02
13A–CH standard (non-thermal) - post-verification	5.0E-05	7.3E-04	3.8E-09	6.6E-03	2.8E-04	6.4E-04
13B–CH standard – post-verification	8.4E-06	1.2E-04	6.3E-10	1.1E-03	4.8E-05	1.1E-04
14–Elemental lead	0	0	0	4.9E-03	2.1E-04	1.9E-04
15–Elemental mercury	0	0	0	1.3E-03	5.5E-05	4.9E-05
22–WTP melters	1.7E-07	2.4E-06	1.2E-11	2.2E-05	9.4E-07	2.1E-06
Total MLLW	2.4E-02	1.1E-01	2.5E-06	1.8	4.9E-02	1.2E-01
TRU Wastes						
WRAP						
4–Retrievably stored drums in trenches	8.4E-06	1.2E-03	2.0E-08	2.8E-04	1.2E-05	2.7E-05
9–Newly generated and existing CH standard containers	1.6E-03	1.1E-02	4.3E-06	5.2E-02	2.2E-03	2.0E-03
T Plant Complex						
17–K Basin sludge	6.4E-05	1.2E-03	1.5E-07	2.2E-03	9.4E-05	8.4E-05
Modified T Plant Complex						
4–Retrievably stored drums in trenches	1.6E-05	2.4E-03	3.9E-08	5.3E-04	2.3E-05	5.1E-05
5–RH TRU waste in caissons	4.1E-07	1.6E-05	8.9E-10	1.4E-05	6.2E-07	1.4E-06
8–TRU commingled PCB waste	1.8E-07	2.6E-05	4.4E-10	6.0E-06	2.6E-07	5.7E-07

Table H.12. (contd)

Onsite Shipments	Radiological Impacts, LCFs: Incident-Free Transport: Workers	Radiological Impacts, LCFs: Incident-Free Transport: Public	Radiological Impacts, LCFs: Accidents: Public	Total Number of Accidents	Non-Radiological Impacts: Number of Fatalities	Non-Radiological Impacts: Emissions LCFs
10A–Newly generated CH non-standard	6.2E-05	4.3E-04	1.7E-07	2.0E-03	8.6E-05	7.7E-05
10B–Newly generated RH TRU waste	9.9E-04	1.8E-02	2.4E-06	3.4E-02	1.5E-03	1.3E-03
LLBGs						
4–TRU drums assayed in trench as LLW			Remains in trench – not transported			
4–TRU assayed as LLW in T Plant/WRAP	1.7E-06	2.5E-05	6.8E-12	2.2E-04	9.6E-06	2.2E-05
4–TRU assayed in T Plant as LLW	3.8E-06	6.7E-05	9.2E-09	1.3E-04	5.4E-06	1.2E-06
9–Drums assayed in WRAP as LLW	6.9E-07	1.0E-04	1.7E-09	2.3E-05	9.8E-07	2.2E-06
10A–TRU assayed in T Plant as CH LLW	1.2E-07	1.8E-06	4.9E-13	1.6E-05	6.9E-07	1.5E-06
10B–TRU assayed in T Plant as RH LLW	2.1E-06	3.0E-05	1.6E-09	2.7E-04	1.2E-05	2.6E-05
Total TRU	2.7E-03	3.4E-02	7.1E-06	9.1E-02	3.9E-03	3.6E-03
ILAW	5.4E-03	6.9E-02	1.6E-09	5.4E-02	2.3E-03	2.6E-03

Note: Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

CH = contact-handled.
RH = remote-handled.
WTP = Waste Treatment Plant.

Table H.13. Transportation Impacts of Alternative Group B – Hanford Only Waste Volume, Number of Fatalities[(a)]

Onsite Shipments	Radiological Impacts, LCFs – Incident-Free Transport – Workers	Radiological Impacts, LCFs – Incident-Free Transport – Public	Radiological Impacts, LCFs – Accidents – Public	Total Number of Accidents	Non-Radiological Impacts – Number of Fatalities	Non-Radiological Impacts – Emissions LCFs
LLW						
WRAP						
1B–LLW Cat 1	5.6E-05	3.3E-04	1.6E-10	6.2E-03	2.7E-04	2.4E-04
2C–LLW Cat 3	1.8E-04	1.2E-03	1.2E-07	2.3E-02	9.9E-04	8.8E-04
T Plant Complex						
1B2–LLW Cat 1	1.5E-07	2.3E-06	6.2E-13	2.0E-05	8.8E-07	2.0E-06
2C2–LLW Cat 3	6.8E-07	1.0E-05	5.4E-10	9.0E-05	3.9E-06	8.7E-06
Offsite Commercial Facilities						
6–LLW (non-conforming)	5.0E-06	3.0E-05	1.5E-11	5.6E-04	2.4E-05	2.1E-05
Repackage in HICs, In-trench Grouting						
2A–LLW Cat 3 direct disposal	4.3E-03	2.9E-02	2.9E-06	5.6E-01	2.4E-02	2.1E-02
2C1–LLW Cat 3 from WRAP	6.3E-06	9.2E-05	5.0E-09	8.3E-04	3.6E-05	8.0E-05
2C2–LW Cat 3 from T Plant	1.0E-06	1.5E-05	8.1E-10	1.3E-04	5.8E-06	1.3E-05
LLBGs						
1A–LLW Cat 1 direct disposal	1.1E-03	6.7E-03	3.2E-09	1.2E-01	5.3E-03	4.8E-03
1A–LLW Cat 1 from Stream 11	2.6E-06	1.6E-05	7.7E-12	2.9E-04	1.3E-05	1.1E-05
1B1–LLW Cat 1 from WRAP	1.7E-06	2.5E-05	6.9E-12	2.3E-04	9.7E-06	2.2E-05
1B2–LLW Cat 1 from T Plant	2.3E-07	3.4E-06	9.3E-13	3.1E-05	1.3E-06	3.0E-06
6–LLW (non-conforming)	1.0E-05	6.0E-05	2.9E-11	1.1E-03	4.8E-05	4.3E-05
Total LLW	5.7E-03	3.8E-02	3.0E-06	7.1E-01	3.1E-02	2.8E-02
MLLW						
WRAP						
11–Wastes ready for disposal	6.0E-06	4.1E-05	1.5E-10	7.7E-04	3.3E-05	3.0E-05
13–Waste verification	3.3E-06	4.9E-05	1.0E-10	4.4E-04	1.9E-05	4.3E-05
13–Post-verification	3.3E-06	4.9E-05	1.0E-10	4.4E-04	1.9E-05	4.3E-05
MLLW determined to be LLW	2.2E-07	3.2E-06	6.8E-12	2.9E-05	1.2E-06	2.8E-06
13B–CH standard (thermal) verification	5.6E-05	2.2E-04	6.2E-09	3.5E-03	7.8E-05	3.6E-04
New Waste Processing Facility						
12–RH MLLW	1.4E-05	2.0E-04	1.9E-10	1.8E-03	7.8E-05	1.8E-04
13A, B–CH standard	3.3E-05	4.8E-04	1.8E-10	4.4E-03	1.9E-04	4.2E-04
14–Elemental lead	0	0	0	9.9E-05	4.2E-06	9.5E-06
15–Elemental mercury	0	0	0	3.5E-06	1.5E-07	3.3E-07
Offsite Treatment Facility						
13B–CH standard (thermal)	5.6E-04	2.2E-03	6.2E-08	3.5E-02	7.8E-04	3.6E-03
MLLW Enhanced Trench Design						
11–Wastes ready for disposal	8.5E-04	5.8E-03	2.2E-08	1.1E-01	4.7E-03	4.2E-03
11–From WRAP verification	2.3E-06	3.4E-05	7.2E-11	3.1E-04	1.3E-05	3.0E-06
12–RH MLLW from NWPF	5.1E-05	7.4E-04	3.8E-09	6.7E-03	2.9E-04	6.4E-04
13A,B–CH standard	5.8E-05	8.5E-04	1.8E-09	7.7E-02	3.3E-03	7.4E-03
13B–CH standard (thermal)	5.0E-04	2.0E-03	5.6E-08	3.2E-02	7.0E-04	3.2E-03

Table H.13. (contd)

Onsite Shipments	Radiological Impacts, LCFs: Incident-Free Transport: Workers	Radiological Impacts, LCFs: Incident-Free Transport: Public	Radiological Impacts, LCFs: Accidents: Public	Total Number of Accidents	Non-Radiological Impacts: Number of Fatalities	Non-Radiological Impacts: Emissions LCFs
14–Elemental lead	0	0	0	2.0E-03	8.5E-05	1.9E-04
15–Elemental mercury	0	0	0	5.1E-04	2.2E-05	4.9E-05
22–WTP melters	1.7E-07	2.4E-06	1.2E-11	2.2E-05	9.4E-07	2.1E-06
Total MLLW	2.1E-03	1.3E-02	1.6E-07	2.8E-01	1.0E-02	2.0E-02
TRU Wastes						
WRAP						
4–Retrievably stored drums in trenches	8.4E-06	1.2E-03	2.0E-08	2.8E-04	1.2E-05	2.7E-05
9–Newly generated and existing CH standard containers	1.6E-03	1.1E-02	4.3E-06	5.2E-02	2.2E-03	2.0E-03
T Plant Complex						
17–K Basin sludge	6.4E-05	1.2E-03	1.5E-07	2.2E-03	9.4E-05	8.4E-05
New Waste Processing Facility						
4–Retrievably stored drums in trenches	1.6E-05	2.4E-03	3.9E-08	5.3E-04	2.3E-05	5.1E-05
5–RH TRU waste in caissons	4.1E-07	1.6E-05	8.9E-10	1.4E-05	6.2E-07	1.4E-06
8–TRU commingled PCB waste	1.8E-07	2.6E-05	4.4E-10	6.0E-06	2.6E-07	5.7E-07
10A–Newly generated CH non-standard	6.2E-05	4.3E-04	1.7E-07	2.0E-03	8.6E-05	7.7E-05
10B–Newly generated RH TRU waste	9.9E-04	1.8E-02	2.4E-06	3.4E-02	1.5E-03	1.3E-03
LLBGs						
4–TRU drums assayed in trench as LLW	Remains in trench – not transported					
4–TRU assayed as LLW in NWPF/WRAP	1.7E-06	2.5E-05	6.8E-12	2.2E-04	9.6E-06	2.2E-05
4–TRU assayed in NWPF as LLW	3.8E-06	6.7E-05	9.2E-09	1.3E-04	5.4E-06	1.2E-05
9–Drums assayed in WRAP as LLW	1.7E-07	2.5E-06	6.9E-13	2.3E-05	9.8E-07	2.2E-06
10A–TRU assayed in NWPF as CH LLW	1.2E-07	1.8E-06	4.9E-13	1.6E-05	6.9E-07	1.5E-06
10B– TRU assayed in NWPF as RH LLW	2.1E-06	3.0E-05	1.6E-09	2.7E-04	1.2E-05	2.6E-05
Total TRU Wastes	2.7E-03	3.4E-02	7.1E-06	9.1E-02	3.9E-03	3.6E-03
ILAW	5.4E-02	6.9E-01	1.6E-08	5.4E-01	2.3E-02	2.6E-02

Note: Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

CH = contact-handled.
RH = remote-handled.
NWPF = new waste processing facility.
WTP = Waste Treatment Plant.

Table H.14. Transportation Impacts for the No Action Alternative, Hanford Only Waste Volume, Number of Fatalities[(a)]

Onsite Shipments	Radiological Impacts, LCFs			Total Number of Accidents	Non-Radiological Impacts	
	Incident-Free Transport		Accidents			
	Workers	Public	Public		Number of Fatalities	Emissions LCFs
LLW						
WRAP						
1B–LLW Cat 1	5.6E-05	3.3E-04	1.6E-10	6.2E-03	2.7E-04	2.4E-04
2B–LLW Cat 3	1.8E-04	1.2E-03	1.2E-07	2.3E-02	9.9E-04	8.8E-04
T Plant Complex						
1B2–LLW Cat 1	1.5E-07	2.3E-06	6.2E-13	2.0E-05	8.8E-07	2.0E-05
2C2–LLW Cat 3	6.8E-07	1.0E-05	5.4E-10	9.0E-05	3.9E-06	8.7E-05
Repackage in HICs or Trench Grouting						
2A–LLW Cat 3 direct disposal	4.3E-03	2.9E-02	2.9E-06	5.6E-01	2.4E-02	2.1E-02
2C1–LLW Cat 3 from WRAP	6.3E-06	9.2E-05	5.0E-09	8.3E-04	3.6E-05	8.0E-04
2C2–LLW Cat 3 from the T Plant	1.0E-06	1.5E-05	8.1E-10	1.3E-04	5.8E-06	1.3E-04
LLBGs						
1A–LLW Cat 1 direct disposal	1.1E-03	6.7E-03	3.2E-09	1.2E-01	5.3E-03	4.8E-03
1A–LLW Cat 1 from Stream 11	2.6E-06	1.6E-05	7.7E-12	2.9E-04	1.3E-05	1.1E-05
1B1–LLW Cat 1 from WRAP	1.7E-05	2.5E-04	1.4E-08	2.3E-04	9.7E-06	2.2E-04
1B2–LLW Cat 1 from T Plant	2.3E-06	3.4E-05	1.9E-09	3.1E-05	1.3E-06	3.0E-05
Total LLW	5.7E-03	3.8E-02	3.0E-06	7.1E-01	3.0E-02	2.9E-02
MLLW						
WRAP						
11–Wastes ready for disposal	6.5E-06	4.5E-05	1.7E-10	8.4E-04	3.6E-05	3.2E-05
13–Waste verification	3.3E-06	4.9E-05	1.0E-10	4.4E-04	1.9E-05	4.3E-04
13–Offsite treatment verification	2.7E-07	1.9E-06	1.7E-11	3.5E-05	1.5E-06	1.4E-06
Commercial Treatment Facilities						
13B–CH standard (thermal)	2.7E-06	1.9E-05	1.7E-10	3.5E-04	1.5E-05	1.4E-05
Central Waste Complex						
11–Wastes ready for indefinite storage	5.8E-04	3.9E-03	1.5E-08	7.5E-02	3.2E-03	2.9E-03
–RH and non-standard packages	3.5E-04	2.4E-03	9.2E-09	4.6E-02	2.0E-03	1.8E-03
13A,B–CH solids and debris	8.5E-04	5.8E-03	2.2E-08	1.1E-01	4.7E-03	4.2E-03
13–Post WRAP verification	3.3E-06	4.9E-05	1.0E-10	4.4E-04	1.9E-05	4.3E-04
14–Elemental lead	0	0	0	2.5E-03	1.1E-04	9.5E-05
15–Elemental mercury	0	0	0	8.6E-05	3.7E-06	3.3E-06
22–WTP melters	1.7E-06	2.4E-05	5.1E-11	2.2E-04	9.4E-06	2.1E-05
200 E LLBG Existing Design Trenches						
11–Wastes ready for disposal	8.5E-04	5.8E-03	2.2E-08	1.1E-01	4.7E-03	4.2E-03
11–Post-verification wastes from WRAP	1.4E-06	2.1E-05	4.3E-11	1.9E-04	8.0E-06	1.8E-05
13B–CH standard (thermal) from WRAP verification	4.5E-07	6.6E-06	1.4E-11	5.9E-05	2.5E-06	5.7E-06

Table H.14. (contd)

Onsite Shipments	Radiological Impacts, LCFs — Incident-Free Transport: Workers	Radiological Impacts, LCFs — Incident-Free Transport: Public	Radiological Impacts, LCFs — Accidents: Public	Total Number of Accidents	Non-Radiological Impacts: Number of Fatalities	Non-Radiological Impacts: Emissions LCFs
13B–CH standard (thermal) from Comm Treat	2.5E-06	1.7E-05	1.5E-10	3.2E-04	1.4E-05	1.2E-05
Total MLLW	2.7E-03	1.8E-02	6.9E-08	3.4E-01	1.5E-02	1.4E-02
TRU Wastes						
WRAP						
4–Retrievably stored drums in trenches	8.4E-05	1.5E-03	2.0E-07	2.8E-03	1.2E-04	2.7E-04
9–CH - standard containers						
- 208-L (55-gal) drums	3.5E-04	2.4E-03	9.5E-07	1.1E-02	4.9E-04	4.4E-04
- Standard waste boxes	1.6E-03	1.1E-02	4.4E-06	5.3E-02	2.3E-03	2.0E-03
Storage at CWC or T Plant Complex						
4–TRU to indefinite storage	1.6E-04	2.8E-03	3.9E-07	5.3E-03	2.3E-04	5.1E-04
5–RH TRU in caissons	4.1E-07	1.6E-05	8.9E-10	1.4E-05	6.2E-07	1.4E-05
8–TRU commingled PCB waste	4.6E-06	3.2E-05	1.2E-08	1.5E-04	6.4E-06	5.7E-06
10A– Newly generated CH non-standard	6.2E-05	4.3E-04	1.7E-07	2.0E-03	8.6E-05	7.7E-05
10B–Newly generated RH waste	9.9E-04	1.8E-02	2.4E-06	3.4E-02	1.5E-03	1.3E-03
17–K Basin sludge	6.4E-05	1.2E-03	1.5E-07	2.2E-03	9.4E-05	8.4E-05
LLBGs						
4–Drums assayed in WRAP as LLW	2.1E-07	3.1E-06	8.4E-13	2.8E-05	1.2E-06	2.7E-05
9–Drums assayed in WRAP as LLW	1.7E-07	2.5E-06	6.9E-13	2.3E-05	9.8E-07	2.2E-05
Total TRU Wastes	3.4E-03	3.7E-02	8.7E-06	1.1E-01	4.7E-03	4.8E-03
ILAW	Intrafacility Transfer					

Note: Due to rounding, the sums of the numbers in the table may not exactly match the totals.
(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.
CH = contact-handled.
RH = remote-handled.
WTP = Waste Treatment Plant.

H.3.1.7 Summary of Transportation Impacts for the Hanford Only Waste Volume

Table H.15 presents the results of the analysis of potential transportation impacts of shipping Hanford Only waste volume of LLW, MLLW, TRU wastes, and ILAW onsite and the small volumes of Hanford LLW and MLLW to offsite treatment facilities and back. Shipments of additional LLW, MLLW, and TRU wastes to Hanford from offsite and shipments of TRU wastes from Hanford to WIPP are addressed in Section H.3.2. All of the impacts provided in Table H.15 are fatalities, except for the estimated number of traffic accidents. Fatalities are expressed as latent cancer fatalities (LCFs) for radiological impacts and for incident-free non-radiological emissions. For non-radiological accidents, impacts are expressed in terms of the predicted number of traffic accidents and fatalities from physical trauma resulting from those traffic accidents. Note that many of the entries in the table are expressed as fractional fatalities (for example, 1.0E-01 or 0.1 fatalities). However, fatalities occur only as whole numbers and the totals have been obtained by rounding to the nearest whole number.

Table H.15 indicates that the No Action Alternative results in the lowest total (that is, the sums across all waste types) potential onsite radiological impacts of all the alternative groups. This is primarily because, under the No Action Alternative, ILAW would be placed in concrete vaults adjacent to the Waste Treatment Plant (WTP) and, thus, is assumed not to involve transportation. For the action alternatives, Alternative Group B has the largest total radiological incident-free impacts. Radiological incident-free impacts are dominated by the large volume and high number of shipments of ILAW to a disposal facility located in the 200 West Area. The potential radiological incident-free impacts associated with ILAW transportation are lower for Alternative Groups A, C, D, and E than for Alternative Group B because in Alternative Groups A, C, D, and E, the shipping distance is shorter because the ILAW disposal facility is assumed to be located in the 200 East Area (the WTP is also located in the 200 East Area). In addition, the volumes of Hanford MLLW shipped to offsite treatment facilities and back are smaller in Alternative Group B than in the other action alternative groups. Only Alternative Group B was predicted to result in a radiological fatality from onsite shipments of solid waste due primarily to the longer ILAW shipping distance relative to the other action alternatives.

Table H.15. Summary of Impacts of Shipping Hanford Only Wastes Volume for Each Alternative Group(a)(b)

Waste Type	Radiological Impacts, LCFs			Total Number of Accidents	Non-Radiological Impacts	
	Occupational	Non-Occupational	Radiological Accidents		Accident Fatalities	Emissions, LCFs
Alternative Groups A, C, D, E						
LLW	5.7E-03	3.8E-02	3.0E-06	7.1E-01	3.1E-02	2.8E-02
MLLW	2.4E-02	1.1E-01	2.5E-06	1.8	4.7E-02	1.5E-01
TRU	2.7E-03	3.4E-02	7.1E-06	9.1E-02	3.9E-03	3.6E-03
ILAW	5.4E-03	6.9E-02	1.6E-09	5.4E-02	2.3E-03	2.6E-03
Total	0 (3.8E-02)	0 (2.5E-01)	0 (1.3E-05)	3 (2.6)	0 (8.5E-02)	0 (1.8E-01)
Alternative Group B						
LLW	5.7E-03	3.8E-02	3.0E-06	7.1E-01	3.1E-02	2.8E-02
MLLW	2.1E-03	1.3E-02	1.6E-07	2.8E-01	1.0E-02	2.0E-02
TRU	2.7E-03	3.4E-02	7.1E-06	9.1E-02	3.9E-03	3.6E-03
ILAW	5.4E-02	6.9E-01	1.6E-08	5.4E-01	2.3E-02	2.6E-02
Total	0 (6.4E-02)	1 (7.7E-01)	0 (1.0E-05)	2 (1.6)	0 (6.8E-02)	0 (7.8E-02)
No Action Alternative						
LLW	5.7E-03	3.8E-02	3.0E-06	7.1E-01	3.0E-02	2.9E-02
MLLW	2.7E-03	1.8E-02	6.9E-08	3.4E-01	1.5E-02	1.4E-02
TRU	3.4E-03	3.7E-02	8.7E-06	1.1E-01	4.7E-03	4.8E-03
ILAW	Intrafacility Transfer					
Total	0 (1.2E-02)	0 (9.4E-02)	0 (1.2E-05)	1 (1.2)	0 (5.0E-02)	0 (4.7E-02)

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) This table presents the potential impacts of onsite shipments of LLW, MLLW, TRU wastes, and ILAW in addition to shipments of Hanford LLW and MLLW to offsite treatment facilities and back. The table does not include the impacts of shipments of LLW, MLLW, and TRU wastes from offsite or the impacts of transporting TRU wastes to WIPP (see Section H.3.2),

(b) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

Total non-radiological impacts are also lowest for the No Action Alternative. However, for the action alternatives, the potential impacts are larger for Alternative Groups A, C, D, and E than they are for Alternative Group B. This is because the potential non-radiological impacts are dominated by the shipments of Hanford Only waste volume of MLLW to offsite treatment facilities and back. There are fewer shipments to offsite treatment facilities and back in Alternative Group B than in Alternative Groups A, C, D, and E. None of the action alternative groups was predicted to result in a non-radiological fatality from shipments of the Hanford Only waste volume.

H.3.2 Results of Offsite Transportation Impact Analysis

This section presents the results of the offsite transportation impact analysis, except for the impacts of shipping Hanford MLLW to offsite treatment facilities and back that were presented in Section H.3.1. The results presented include the impacts of possible shipments to Hanford from offsite as well as the impacts of shipping TRU wastes from Hanford to WIPP. Section H.3.2.1 presents the potential radiological impacts to populations along the highway routes and Section H.3.2.2 presents the non-radiological impacts. The analysis of maximally exposed individuals to incident-free transport conditions is presented in Section H.3.2.3.

H.3.2.1 Potential Population Radiological Impacts of Offsite Shipments

The potential radiological impacts of offsite shipments of solid waste to and from Hanford through 2046 are shown in Table H.16. Impact estimates are presented for shipments of LLW, MLLW, and TRU wastes from offsite to Hanford under the Upper Bound and Lower Bound waste volume projections as well as shipments of TRU wastes from Hanford to WIPP under the action alternative groups and the No Action Alternative. Note that the impact estimates for the Lower Bound waste volume projection are dominated by shipments of TRU wastes from Hanford to WIPP. For the Upper Bound waste volume projection, additional shipments contribute to the total impacts, including shipments of LLW from ORR, Rocky Flats Field Office, and Argonne National Laboratory-East to Hanford as well as MLLW shipments from the Savannah River Site and ORR to Hanford. There are only small differences in TRU waste shipping volumes from Hanford to WIPP between the Lower Bound and Upper Bound waste volumes.

Table H.17 summarizes the radiological impacts of offsite shipments to and from Hanford by waste type. As shown, the sums of the radiological incident-free impact estimates (worker plus public) are 2 LCFs for the Hanford Only waste volume of TRU waste to WIPP under the No Action Alternative, 5 LCFs for the Hanford Only waste volume of TRU waste to WIPP under the action alternative groups, 5 LCFs for the Lower Bound waste volume projection, and 7 LCFs for the Upper Bound waste volume projection. Radiological accident impacts are 0 for all four waste volume projections. These values are small in comparison to the cancer fatalities from other causes that would be calculated over the next 40 years.

Table H.16. Radiological Transportation Impacts for Offsite Shipments[(a)(b)]

Waste Type/Generator	LOWER BOUND			UPPER BOUND		
	Radiological Impacts, LCFs			Radiological Impacts, LCFs		
	Incident-Free Transport		Accidents	Incident-Free Transport		Accidents
	Workers	Public	Public	Workers	Public	Public
LLW						
Ames Laboratory (Ames, Iowa)	8.6E-05	2.9E-04	7.8E-06	8.6E-05	2.9E-04	7.8E-06
Argonne National Laboratory-East	1.3E-02	4.6E-02	1.3E-03	1.3E-02	4.6E-02	1.3E-03
Battelle Columbus Laboratory	1.1E-03	4.3E-03	9.9E-05	1.1E-03	4.3E-03	9.9E-05
Bettis Atomic Power Laboratory	8.7E-04	3.7E-03	1.1E-04	8.7E-04	3.7E-03	1.1E-04
Bettis Atomic Power Shipyards	2.2E-05	9.4E-05	2.9E-06	2.2E-05	9.4E-05	2.9E-06
Brookhaven National Laboratory	3.0E-03	1.5E-02	6.1E-08	2.8E-02	1.4E-01	5.7E-07
Energy Technology Engineering Center	1.2E-03	7.0E-03	1.7E-04	1.3E-03	7.5E-03	1.9E-04
Fermi National Accelerator Laboratory	1.9E-03	6.4E-03	1.7E-04	1.9E-03	6.4E-03	1.7E-04
General Electric Vallecitos	0	0	0	1.9E-05	1.3E-04	1.0E-09
Grand Junction Projects Office	0	0	0	3.5E-05	2.3E-04	7.1E-06
Idaho National Engineering and Environmental Laboratory	0	0	0	2.4E-03	8.9E-03	2.5E-04

Table H.16. (contd)

Waste Type/Generator	LOWER BOUND Radiological Impacts, LCFs Incident-Free Transport		Accidents	UPPER BOUND Radiological Impacts, LCFs Incident-Free Transport		Accidents
Inhalation Toxicology Research Institute	0	0	0	6.5E-04	3.0E-03	9.2E-08
Knolls Atomic Power Shipyards	6.6E-04	2.9E-03	7.9E-05	6.6E-04	2.9E-03	7.9E-05
Lawrence Berkeley National Laboratory	1.2E-04	8.6E-04	2.2E-05	1.2E-04	8.6E-04	2.2E-05
Lawrence Livermore National Laboratory	0	0	0	7.3E-03	5.1E-02	1.2E-06
MIT/Bates Linear Accelerator Center	2.8E-05	1.3E-04	6.2E-06	2.8E-05	1.3E-04	6.2E-06
Oak Ridge Reservation	0	0	0	1.2E-01	4.9E-01	8.6E-04
Paducah Gaseous Diffusion Plant	7.7E-05	3.1E-04	1.1E-05	7.7E-05	3.1E-04	1.1E-05
Pantex Facility	0	0	0	1.2E-03	5.3E-03	2.9E-08
Princeton Plasma Physics Laboratory	3.8E-03	1.7E-02	7.7E-04	3.8E-03	1.7E-02	7.7E-04
Rocky Flats Plant	0	0	0	4.5E-02	1.8E-01	6.6E-09
Sandia National Laboratories	0	0	0	2.2E-03	1.1E-02	2.6E-05
Separations Process Research Unit	0	0	0	1.5E-02	6.7E-02	5.1E-07
Stanford Linear Accelerator	5.4E-04	4.4E-03	1.1E-04	5.4E-04	4.4E-03	1.1E-04
West Valley Nuclear Services	0	0	0	1.8E-02	7.9E-02	1.4E-04
Total LLW	2.7E-02	1.1E-01	2.9E-03	2.7E-01	1.1	4.2E-03
MLLW						
Battelle Columbus Laboratory	2.0E-05	6.8E-05	2.2E-06	2.0E-05	6.8E-05	2.2E-06
Energy Technology Engineering Center	0	0	0	1.1E-03	7.2E-03	5.6E-12
Idaho National Engineering and Environmental Laboratory	0	0	0	7.3E-05	2.8E-04	7.2E-06
Knolls Atomic Power Laboratory	2.6E-05	1.2E-04	3.8E-06	2.6E-05	1.2E-04	3.8E-06
Battelle Columbus Laboratory	2.0E-05	6.8E-05	2.2E-06	2.0E-05	6.8E-05	2.2E-06
Energy Technology Engineering Center	0	0	0	1.1E-03	7.2E-03	5.6E-12
Idaho National Engineering and Environmental Laboratory	0	0	0	7.3E-05	2.8E-04	7.2E-06
Knolls Atomic Power Laboratory	2.6E-05	1.2E-04	3.8E-06	2.6E-05	1.2E-04	3.8E-06
Los Alamos National Laboratory	0	0	0	2.6E-03	1.3E-02	4.3E-10
Oak Ridge Reservation	0	0	0	8.6E-02	3.4E-01	9.6E-06
Paducah Gaseous Diffusion Plant	0	0	0	3.6E-03	1.5E-02	1.5E-04
Portsmouth Gaseous Diffusion Plant	0	0	0	4.6E-03	2.0E-02	6.5E-07
Princeton Plasma Physics Laboratory	1.8E-04	8.2E-04	4.5E-05	1.8E-04	8.2E-04	4.5E-05
Puget Sound Naval Shipyards	3.4E-06	2.3E-05	3.9E-07	3.4E-06	2.3E-05	3.9E-07
Rocky Flats Plant	0	0	0	4.7E-02	1.9E-01	5.2E-07
Sandia National Laboratory	0	0	0	1.4E-04	7.1E-04	1.7E-08
Savannah River Site	0	0	0	1.1E-02	4.9E-02	3.3E-05
West Valley Nuclear Services	0	0	0	4.6E-05	2.0E-04	3.4E-13
Total MLLW	2.3E-04	1.0E-03	5.1E-05	1.6E-01	6.4E-01	2.5E-04
CH TRU Waste						
Battelle Columbus Laboratories	3.9E-05	3.4E-04	8.8E-07	3.9E-05	3.4E-04	8.8E-07
Energy Technology Engineering Center	2.3E-05	3.0E-04	6.6E-07	2.3E-05	3.0E-04	6.6E-07
General Electric-Vallecitos Nuclear Center.	0	0	0	7.2E-05	1.1E-03	2.6E-06
Lawrence Berkeley National Laboratory	0	0	0	1.8E-04	2.6E-04	6.5E-07
Lawrence Livermore National Laboratory	0	0	0	3.0E-03	4.4E-02	1.1E-04

Table H.16. (contd)

Waste Type/Generator	LOWER BOUND Radiological Impacts, LCFs			UPPER BOUND Radiological Impacts, LCFs		
	Incident-Free Transport		Accidents	Incident-Free Transport		Accidents
Nevada Test Site	0	0	0	4.9E-04	5.7E-03	1.9E-05
Total CH TRU Waste	6.2E-05	6.3E-04	1.5E-06	3.8E-03	5.1E-02	1.3E-04
RH TRU Waste						
Battelle Columbus Laboratories	1.1E-03	2.4E-02	2.2E-05	1.1E-03	2.4E-02	2.2E-05
Energy Technology Engineering Center	3.7E-04	1.3E-02	9.6E-06	3.7E-04	1.3E-02	9.6E-06
Framatome ANP	0	0	0	1.1E-06	7.4E-06	2.3E-11
General Electric-Vallecitos Nuclear Center	0	0	0	9.7E-04	3.7E-02	3.1E-05
Total RH TRU Waste	1.4E-03	3.7E-02	3.1E-05	2.4E-03	7.4E-02	6.2E-05
Shipments from Hanford to WIPP						
CH TRU waste to WIPP	1.9E-01	1.8	5.4E-03	2.0E-01	1.9	5.6E-03
RH TRU waste to WIPP	1.0E-01	2.6	2.6E-03	1.0E-01	2.6	2.7E-03
Total TRU to WIPP	2.9E-01	4.4	8.1E-03	3.0E-01	4.5	8.3E-03
Action Alternative Groups (Hanford Only Waste Volume of TRU Waste to WIPP)						
CH TRU waste to WIPP	1.9E-01	1.8	5.4E-03	Not Applicable		
RH TRU waste to WIPP	1.0E-01	2.5	2.6E-03			
Total TRU Waste to WIPP	2.9E-01	4.4	8.0E-03			
No Action Alternative (Hanford Only Waste Volume of TRU Waste to WIPP)						
CH TRU waste to WIPP	1.5E-01	1.4	4.3E-03	Not Applicable		

Note: Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs.

(b) The LCF numbers were calculated for each impact category (e.g., worker incident-free impacts) by summing across all waste types and shipments to and from Hanford. For radiological accidents, 0 LCFs were calculated for both the Upper Bound and Lower Bound projections. To illustrate the Upper Bound calculations, the subtotals for LLW, MLLW, and TRU shipments to Hanford were added together (2.9E-03 + 5.1E-05 + 1.5E-06 + 3.1E-05) and then the impacts of CH and RH TRU shipments from Hanford to WIPP (8.1E-03) were added in. The total is about 0.01 LCFs, which rounds to 0.

Table H.17. Summary of Potential Radiological Transportation Impacts for Offsite Shipments by Waste Type[(a)]

Waste Type	Radiological Impacts		
	Incident-Free Transport, LCFs		Accidents, LCFs
	Worker	Public	Public
Lower Bound			
LLW to Hanford	2.7E-02	1.1E-01	2.9E-03
MLLW to Hanford	2.3E-04	1.0E-03	5.1E-05
CH TRU waste to Hanford	6.2E-05	6.3E-04	1.5E-06
RH TRU waste to Hanford	1.4E-03	3.7E-02	3.1E-05
CH TRU waste to WIPP	1.9E-01	1.8	5.4E-03
RH TRU waste to WIPP	1.0E-01	2.6	2.6E-03
Total	0 (3.2E-01)	5 (4.5)	0 (1.1E-02)
Upper Bound			
LLW to Hanford	2.7E-01	1.1	4.2E-03
MLLW to Hanford	1.6E-01	6.4E-01	2.5E-04
CH TRU waste to Hanford	3.8E-03	5.1E-02	1.3E-04
RH TRU waste to Hanford	2.4E-03	7.4E-02	6.2E-05
CH TRU waste to WIPP	2.0E-01	1.9	5.6E-03
RH TRU waste to WIPP	1.0E-01	2.6	2.7E-03
Total	1 (7.3E-01)	6 (6.4)	0 (1.3E-02)
Action Alternative Groups (Hanford Only Waste Volume of TRU Waste)			
CH TRU waste to WIPP	1.9E-01	1.8	5.4E-03
RH TRU waste to WIPP	1.0E-01	2.5	2.6E-03
Total	0 (2.9E-01)	4 (4.4)	0 (8.0E-03)
No Action Alternative (Hanford Only Waste Volume of TRU Waste)			
CH TRU Waste to WIPP	0 (1.5E-01)	1 (1.4)	0 (4.3E-03)

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs.

H.3.2.2 Potential Non-Radiological Impacts of Offsite Shipments

The results of the non-radiological transportation impact analysis are presented in Table H.18 for each offsite generator. The table includes the number of traffic accidents, number of non-radiological fatalities from traffic accidents, and the projected impacts from non-radiological emissions. The table includes projections for both the Upper Bound and Lower Bound waste volumes.

Table H.19 summarizes the potential non-radiological impacts of offsite shipments by waste type. As shown, the non-radiological accident fatality estimates are 0 for the Hanford Only waste volume projection under the No Action Alternative, 1 fatality for the Hanford Only waste volume projection under the action alternative groups, 1 fatality for the Lower Bound waste volume projection, and 2 for the Upper Bound waste volume projection. Non-radiological emissions impacts (in LCFs) range from 0 for the Hanford Only waste volume projection under all alternative groups as well as the Lower Bound waste volume projection to 2 for the Upper Bound waste volume.

Table H.18. Non-Radiological Transportation Impacts for Offsite Shipments[a]

Waste Type/Generator	Lower Bound Volume			Upper Bound Volume		
	Total Number of Accidents	Number of Fatalities	Emissions LCFs	Total Number of Accidents	Number of Fatalities	Emissions LCFs
LLW						
Ames Laboratory (Ames, Iowa)	1.2E-02	3.8E-04	2.4E-04	1.2E-02	3.8E-04	2.4E-04
Argonne National Laboratory-East	1.7	5.7E-02	3.4E-02	1.7	5.7E-02	3.4E-02
Battelle Columbus Laboratory	1.3E-01	4.3E-03	3.5E-03	1.3E-01	4.3E-03	3.5E-03
Bettis Atomic Power Laboratory	1.0E-01	3.2E-03	3.4E-03	1.0E-01	3.2E-03	3.4E-03
Bettis Atomic Power Shipyards	2.6E-03	5.6E-05	8.7E-05	2.6E-03	5.6E-05	8.7E-05
Brookhaven National Laboratory	3.8E-01	1.2E-02	2.1E-02	3.6	1.1E-01	2.0E-01
Energy Technology Engineering Center	7.3E-02	4.8E-03	1.2E-02	7.8E-02	5.2E-03	1.3E-02
Fermi National Accelerator Laboratory	3.2E-01	1.0E-02	4.3E-03	3.2E-01	1.0E-02	4.3E-03
General Electric Vallecitos	0	0	0	1.1E-03	8.2E-05	2.2E-04
Grand Junction Projects Office	0	0	0	3.4E-03	1.3E-04	2.5E-04
Idaho National Engineering and Environmental Laboratory	0	0	0	2.4E-01	1.8E-02	6.8E-03
Inhalation Toxicology Research Institute	0	0	0	6.7E-02	2.5E-03	3.5E-03
Knolls Atomic Power Shipyards	7.2E-02	2.3E-03	2.7E-03	7.2E-02	2.3E-03	2.7E-03
Lawrence Berkeley National Laboratory	7.2E-03	5.3E-04	1.5E-03	7.2E-03	5.1E-04	1.5E-03
Lawrence Livermore National Laboratory	0	0	0	4.4E-01	3.2E-02	8.6E-02
MIT/Bates Linear Accelerator Center	3.2E-03	8.4E-05	1.4E-04	3.2E-03	8.4E-05	1.4E-04
Oak Ridge Reservation	0	0	0	1.6E+01	5.0E-01	4.0E-01
Paducah Gaseous Diffusion Plant	1.2E-2	3.6E-4	2.5E-04	1.2E-2	3.6E-4	2.5E-04
Pantex Facility	0	0	0	1.8E-01	7.3E-03	5.3E-03
Princeton Plasma Physics Laboratory	4.7E-01	1.4E-02	1.7E-02	4.7E-01	1.4E-02	1.7E-02
Rocky Flats Plant	0	0	0	6.9	1.8E-01	1.1E-01
Sandia National Laboratories	0	0	0	2.4E-01	1.0E-02	1.5E-02
Separations Process Research Unit	0	0	0	1.6	5.4E-02	6.3E-02
Stanford Linear Accelerator	3.1E-02	2.2E-03	9.2E-03	3.1E-02	2.2E-03	9.2E-03
West Valley Nuclear Services	0	0	0	2.0	6.6E-02	6.9E-02
Total LLW	3.3	1.1E-01	1.1E-01	3.4E+01	1.1	1.0
MLLW						
Battelle Columbus Laboratory	2.2E-03	6.4E-05	6.3E-05	2.2E-03	6.4E-05	6.3E-05
Energy Technology Engineering Center	0	0	0	7.0E-02	4.6E-03	1.2E-02
Idaho National Engineering and Environmental Laboratory	0	0	0	7.6E-03	5.5E-04	2.1E-04
Knolls Atomic Power Laboratory	2.9E-03	9.4E-05	1.1E-04	2.9E-03	9.4E-05	1.1E-04
Los Alamos National Laboratory	0	0	0	4.5E-01	1.3E-02	1.5E-02
Oak Ridge Reservation	0	0	0	1.1E+01	3.5E-1	2.8E-01
Paducah Gaseous Diffusion Plant	0	0	0	5.9E-1	1.8E-2	1.2E-02
Portsmouth Gaseous Diffusion Plant	0	0	0	5.7E-01	1.7E-02	1.9E-02
Princeton Plasma Physics Laboratory	2.2E-02	6.8E-04	7.9E-04	2.2E-02	6.8E-04	7.9E-04
Puget Sound Naval Shipyards	2.4E-04	3.0E-06	4.3E-05	2.4E-04	3.0E-06	4.3E-05

Table H.18. (contd)

Waste Type/Generator	Lower Bound Volume Total Number of Accidents	Lower Bound Volume Number of Fatalities	Lower Bound Volume Emissions LCFs	Upper Bound Volume Total Number of Accidents	Upper Bound Volume Number of Fatalities	Upper Bound Volume Emissions LCFs
Rocky Flats Plant	0	0	0	7.2	1.9E-01	1.2E-01
Sandia National Laboratory	0	0	0	1.5E-02	6.2E-04	9.3E-04
Savannah River Site	0	0	0	1.4	4.5E-02	5.1E-02
West Valley Nuclear Services	0	0	0	5.2E-03	1.7E-04	1.7E-04
Total MLLW	2.8E-02	8.4E-04	1.0E-03	2.1E+01	6.5E-01	5.0E-01
CH TRU Waste						
Battelle Columbus Laboratories	2.9E-03	7.3E-05	6.3E-05	2.4E-03	7.3E-05	6.3E-05
Energy Technology Engineering Center	7.3E-04	4.8E-05	1.2E-04	7.3E-04	4.8E-05	1.2E-04
General Electric-Vallecitos Nuclear Center	0	0	0	2.3E-03	1.6E-04	4.4E-04
Lawrence Berkeley National Laboratory	0	0	0	5.6E-04	4.1E-05	1.2E-04
Lawrence Livermore National Laboratory	0	0	0	9.4E-02	6.8E-03	1.9E-02
Nevada Test Site	0	0	0	2.5E-02	1.0E-03	1.8E-04
Total CH TRU Waste	3.6E-03	1.2E-04	1.9E-04	1.3E-01	8.2E-03	2.1E-02
RH TRU Waste						
Battelle Columbus Laboratories	6.9E-02	2.3E-03	1.8E-03	6.9E-02	2.3E-03	1.8E-03
Energy Technology Engineering Center	1.2E-02	8.2E-04	2.1E-03	1.2E-02	8.2E-04	2.1E-03
Framatome ANP	0	0	0	1.4E-04	6.7E-06	5.4E-06
General Electric-Vallecitos Nuclear Center	0	0	0	3.2E-02	2.3E-03	6.3E-03
Total RH TRU Waste	8.1E-02	3.1E-03	3.9E-03	1.1E-01	5.4E-03	1.0E-02
TRU From Hanford to WIPP	1.7E+01	5.5E-01	3.2E-01	1.7E+01	5.6E-01	3.3E-01
Action Alternative Groups (Hanford Only Waste Volume of TRU Waste)						
CH TRU Waste to WIPP	1.1E+01	3.5E-01	2.0E-01	Not Applicable		
RH TRU Waste to WIPP	6.0E+00	2.0E-01	1.2E-01			
Total TRU Waste to WIPP	17	5.4E-01	3.2E-01			
No Action Alternative (Hanford Only Waste Volume of TRU Waste)						
CH TRU Waste to WIPP	8.4E+00	2.8E-01	1.6E-01	Not Applicable		

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

Table H.19. Summary of Non-Radiological Impacts for Offsite Shipments by Waste Type (Fatalities)[(a)]

Waste Type	Lower Bound			Upper Bound		
	Total Number of Accidents	Number of Fatalities	Non-Radiological Emissions, LCFs	Total Number of Accidents	Number of Fatalities	Non-Radiological Emissions, LCFs
LLW to Hanford	3.3	1.1E-01	1.1E-01	3.4E+01	1.1	1.0
MLLW to Hanford	2.8E-02	8.4E-04	1.0E-03	2.1E+01	6.3E-01	5.0E-01
CH TRU waste to Hanford	3.6E-03	1.2E-04	1.9E-04	1.3E-01	8.2E-03	2.1E-02
RH TRU waste to Hanford	8.1E-02	3.1E-03	3.9E-03	1.1E-01	5.4E-03	1.0E-02
Total from Offsite to Hanford	3.4	1.2E-01	1.1E-01	5.5E+01	1.7	1.6
TRU From Hanford to WIPP	1.7E+01	5.6E-01	3.3E-01	1.7E+01	5.6E-01	3.3E-01
Grand Total	20 (2.0E+01)	1 (6.6E-01)	0 (4.4E-01)	73 (7.3E+01)	2 (2.3)	2 (1.9)
Action Alternative Groups (Hanford Only Waste Volume of TRU Waste)						
CH and RH TRU Waste to WIPP	17	1 (5.4E-01)	0 (1.6E-01)	Not Applicable		
No Action Alternative (Hanford Only Waste Volume of TRU Waste)						
CH TRU waste to WIPP	8 (8.4)	0 (2.8E-01)	0 (1.6E-01)	Not Applicable		

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

The impact estimates for shipments of TRU wastes from Hanford to WIPP are larger than those for shipping all waste types from offsite to Hanford in the Lower Bound case. For the Upper Bound waste volume, the non-radiological impact estimates are lower for the TRU waste shipments to WIPP than the shipments from offsite to Hanford. Note that there are only small differences in estimated impacts (not shown in Table H.19 due to rounding) between the Upper Bound and Lower Bound waste volumes for shipments from Hanford to WIPP. TRU waste shipments from offsite represent a small fraction of the impacts resulting from shipments of LLW and MLLW to Hanford for the Upper Bound waste volume.

H.3.2.3 Results of the Maximally Exposed Individual Impact Analysis

This section presents the results of the analysis of potential impacts to maximally exposed individuals (MEIs). Section H.3.2.3.1 presents the analysis of incident-free radiation exposures and Section H.3.2.3.2 presents the analysis of exposures under accident conditions.

H.3.2.3.1 Incident-Free Radiation Exposures to MEIs

Table H.20 provides the unit doses (rem per shipment) and estimates of the radiation doses and impacts to MEIs for shipments of solid waste to and from the Hanford Site. The risks are calculated for 40 years of shipments. As shown, state inspectors and truck crew members receive the highest individual radiation exposures.

Table H.20. Estimated Doses and Impacts to MEIs[a]

Individual	Unit Dose (rem per shipment)	Dose, Rem	Probability of LCF
Involved Worker			
Truck crew	Not applicable	80[b]	5E-02
Inspector	Not applicable	80[b]	5E-02
Public			
Resident along route[c]	3.8E-05	0.32	2E-04
Person in traffic jam[d]	0.016	0.016	1E-05
Person at service station[e]	3.0E-04	0.84	5E-04

(a) The assumed external dose rate is 10 mrem/hr at 2 m from the vehicle for all shipments.
(b) Totals for 40 years of operation assuming a 2 rem/year administrative dose limit.
(c) The maximally exposed resident along the highway route is assumed to be exposed to all CH and RH TRU shipments from Hanford to WIPP. An exposure distance of 30 m from the shipments was assumed (DOE 1997b).
(d) The person in a traffic jam is assumed to be exposed one time only (DOE 2002b).
(e) The person at a service station is assumed to be exposed to one-third of the CH and RH TRU waste shipments from Hanford to WIPP (based on a 3-shifts-per-day operation). The assumed exposure distance was 16 m (52 ft) and the exposure duration was 49 minutes (DOE 2002b).

DOE determined that the largest potential public radiation exposures would be received by a person at a truck service station who was assumed to be exposed to one-third of the shipments to Hanford from offsite and from Hanford to WIPP. This is based on an assumed 3-shifts-per-day operation for the service station. Based on information provided in Table H.20, the dose estimate to a service station attendant would be about 20 millirem per year. This value was calculated by dividing the total service station attendant dose of 0.84 rem (or 840 millirem) by 40 years of waste management operations. This equates to approximately 20 millirem per year. This would not exceed the maximum allowable dose to a member of the public (100 mrem/yr). Although it is unlikely that the same individual would be present for even one-third of the shipments to and from Hanford, given the extended time period over which shipments would occur, a potential traffic funnel exists at the port of entry into Washington through which all the shipments to and from Hanford could pass. However, actual doses likely are to be even smaller if actual package dose rates are used rather than the regulatory maximum limit.

H.3.2.3.2 Maximum Credible Accident Exposures

This section estimates the impacts from a severe transportation accident. The information in this section was extracted from the WIPP SEIS-II (DOE 1997b). The impacts presented in this section also are representative of the potential radiological impacts of a successful terrorist attack on a waste shipment. The potential impacts presented in this section also were considered to represent those that could occur from a terrorist attack. See Section H.8 for further information on terrorist attacks.

DOE (1997b) estimated the radiological impacts from bounding-case transportation accidents involving TRU wastes. In the analysis, it was assumed that a Severity Category VIII accident occurred, leading to a release of radioactive material from a shipping container. The accident was assumed to occur during very stable meteorological conditions. This has the effect of limiting the dispersion of the released radioactive material, which maximizes the calculated radiation doses. The accident was assumed to occur in an urban area. Bounding and average radionuclide inventories in CH and RH TRU waste accidents were used in this analysis. For conservatism elsewhere in this HSW EIS, the bounding inventories were used for all offsite CH and RH TRU waste shipments (see Table H.10). The results from DOE (1997b) were adjusted to reflect the health effects conversion factor used in the HSW EIS (that is, 6E-04 LCF per person-rem) and are summarized in Table H.21.

Table H.21. Summary of Impacts of Maximum Credible Accidents from DOE (1997b)

Waste Type	Bounding Inventory				Average Inventory			
	Population Dose, person-rem	LCFs[(a)]	Maximum Individual Dose, rem	LCFs	Population Dose, person-rem	LCFs	Maximum Individual Dose, rem	LCFs
CH TRU waste	31,800	19	123	0 (0.07)	6,370	4	80	0 (0.05)
RH TRU waste	32,500	20	125	0 (0.08)	72	0 (0.04)	1.4	0 (0.0008)

(a) LCFs were calculated by multiplying the dose estimates given in DOE (1997b) by 6E-04 LCF per person-rem (or rem).

H.3.3 Summary of Potential Impacts of Onsite and Offsite Waste Shipments

This section summarizes the potential impacts of onsite and offsite waste shipments under all the alternative groups and waste volume cases evaluated in this HSW EIS. In addition, this section presents the results of two sensitivity studies; one examined the potential impacts of increasing cross-country shipments of TRU wastes to Hanford, the other examined inclusion of the TRU wastes from West Valley, New York, to the Upper Bound waste volume.

H.3.3.1 Hanford Solid Waste Management Lifecycle Transportation Impacts

Tables H.22 through H.24 combine the potential transportation impacts of onsite and offsite shipments into three shipment origin-destination categories:

- shipments that take place entirely within the Hanford Site
- shipments of offsite waste to Hanford for treatment, processing, or disposal
- shipments of Hanford waste to offsite facilities for treatment or disposal.

Table H.22 presents the total shipment-miles in these three categories; Table H.23 provides the potential LCF impacts (including radiological incident-free, radiological accident, and non-radiological emissions impacts); and Table H.24 provides the potential non-radiological accident fatalities from traffic accidents. These results are illustrated in Figures H.2 through H.4.

Table H.22 shows that the No Action Alternative results in the lowest shipment-miles for the Hanford Only and Lower Bound waste volumes. This is because only small quantities of waste are transported to and from Hanford in the No Action Alternative. The lowest shipment-miles are projected for the No Action Alternative, Hanford Only waste volume. The action alternatives, Hanford Only waste volume, are the next lowest with respect to shipment-mileage. The projected mileage for Hanford Only waste volume, Alternative Group B, is slightly lower than for Alternative Groups A, C, D, and E due to the smaller volume of MLLW shipped offsite for treatment and back to Hanford for disposal. The greatest shipment-mileage projections are for the Upper Bound waste volume due to the relatively large volumes of MLLW and LLW that would be shipped from offsite to Hanford for disposal.

The potential radiological and non-radiological LCF impacts shown in Table H.23 range from about 2 LCFs for the No Action Alternative, Hanford Only waste volume, to 10 LCFs for the Upper Bound waste volume. Also, within each waste volume, the LCF impacts of Alternative Group B are larger than those for Alternative Groups A, C, D, and E. This is due to the longer ILAW shipping distance onsite in Alternative Group B, which more than offsets the impacts of the additional MLLW shipped offsite for treatment and back to Hanford for disposal in Alternative Groups A, C, D, and E.

The potential radiation and emissions LCF impacts in Table H.23 are projected to occur from exposures to carcinogens (radiation exposures to truck crews and nearby populations and exposures to pollutants in vehicle exhaust) that will take place over the approximately 40 years of waste operations. For perspective, according to the U.S. Centers for Disease Control, National Center for Health Statistics, a total of 10,802 residents of the state of Washington and 7,057 residents of the state of Oregon died of cancer in 2001 (CDC 2003). The cancer mortality rates were 193 and 196 per 100,000 residents, respectively. A total of 36,245 residents of Washington and Oregon were estimated by TRAGIS to live within 800 meters of the highway route between Hanford and Ontario, Oregon. Based on a cancer mortality rate of approximately 200 fatalities per year per 100,000 people, about 70 cancer fatalities per year, or about 2,800 cancer fatalities over a 40-year period, would be estimated in the population along the route from Hanford to Ontario, Oregon, due to causes unrelated to shipments of waste to and from Hanford.

Table H.24 shows that the projected number of fatalities from traffic accidents ranges from 0 for the No Action Alternative, Hanford Only waste volume to about 2 for the Upper Bound waste volume in the action alternative groups. All the other combinations of alternative groups and waste volume cases are projected to result in 1 fatality from traffic accidents.

For additional perspective, the potential transportation impacts from shipments of waste to, from, and within Hanford were compared with traffic accident fatalities from causes unrelated to Hanford waste shipments. According to the U.S. Department of Transportation, National Highway Traffic Safety Administration, there were a total of 649 traffic fatalities in the state of Washington and 488 traffic fatalities in the state of Oregon for a total of 1,137 fatalities in the two states combined for 2001 (DOT 2002). This represents about 3 traffic fatalities per day in the 2 states due to causes unrelated to waste shipments to and from Hanford. This can be compared with the total projected impacts of about 2 traffic fatalities over about 40 years for the Upper Bound waste volume shipments (approximately 0.0002 traffic fatalities per day). Therefore, the total numbers of projected traffic fatalities from 40 years of transporting solid waste to, from, and within Hanford are approximately the same as the traffic fatalities that occur, on average, every day in the states of Washington and Oregon.

Table H.22. Total Shipment-Miles (in millions of miles) by Shipment Origin and Waste Type

	Hanford Only Waste Volume			Lower Bound Waste Volume			Upper Bound Waste Volume		
	No Action Alternative	Alternative Groups A,C,D, E	Alternative Groups B	No Action Alternative	Alternative Groups A,C,D,E	Alternative Groups B	No Action Alternative	Alternative Groups A,C,D,E	Alternative Groups B
Onsite Shipments									
LLW	2.5	2.5	2.5	2.5	2.5	2.5	NA	2.5	2.5
MLLW	1.2	1.5	0.7	1.5	1.5	0.7	NA	1.5	0.7
TRU Wastes	0.4	0.3	0.3	0.4	0.3	0.3	NA	0.3	0.3
ILAW	0	0.2	1.9	0	0.2	1.9	NA	0.2	1.9
Total	4.1	4.6	5.5	4.1	4.6	5.5	NA	4.6	5.5
Offsite Shipments to Hanford									
LLW	NA	NA	NA	6.1	6.1	6.1	NA	59.8	59.8
MLLW (includes MLLW from ORR/Comm Treat and offsite)[a]	<0.1	2.4	0.1	<0.1	2.4	0.2	NA	38.1	35.8
TRU Wastes	NA	NA	NA	0.2	0.2	0.2	NA	0.7	0.7
Total	<0.1	2.4	0.1	6.4	8.7	6.5	NA	98.5	96.3
Hanford to Offsite Facilities									
MLLW to ORR/Comm Treat[a]	<0.1	2.4	0.1	<0.1	2.4	0.1	NA	2.4	0.1
TRU Wastes to WIPP	16.2	31.8	31.8	16.2	36.2	36.2	NA	36.9	36.9
Total	16.2	34.2	32.0	16.2	38.5	36.3	NA	39.3	37.1
GRAND TOTAL	20 (20.4)	41 (41.1)	38 (37.6)	27 (26.7)	52 (51.8)	48 (48.3)	NA	140 (142)	140 (139)

(a) These data include MLLW that is assumed to be shipped to ORR or an offsite commercial treatment facility (comm treat) for treatment and then returned to Hanford for disposal. The Lower Bound waste volume includes a small quantity of MLLW shipped to Hanford for disposal and the Upper Bound waste volume includes shipment of a much larger quantity of MLLW to Hanford for disposal.

NA = not applicable.

Table H.23. Latent Cancer Fatality (LCF) Impacts by Shipment Origin and Waste Type[(a)]

	Hanford Only Waste Volume			Lower Bound Waste Volume			Upper Bound Waste Volume		
	No Action Alternative	**Alternative Groups A,C,D, E**	**Alternative Groups B**	**No Action Alternative**	**Alternative Groups A,C,D,E**	**Alternative Groups B**	**No Action Alternative**	**Alternative Groups A,C,D,E**	**Alternative Groups B**
Onsite Shipments									
LLW	0.072	0.071	0.071	0.072	0.071	0.071	NA	0.071	0.071
MLLW (including melters)	0.035	0.042	0.022	0.035	0.042	0.022	NA	0.042	0.022
TRU Wastes	0.046	0.041	0.04	0.046	0.041	0.04	NA	0.041	0.04
ILAW	0	0.077	0.77	0	0.077	0.77	NA	0.077	0.77
Total	0.15	0.23	0.9	0.15	0.23	0.9	NA	0.23	0.9
Offsite Shipments to Hanford									
LLW	NA	NA	NA	0.25	0.25	0.25	NA	2.4	2.4
MLLW (includes MLLW from ORR/Comm Treat and offsite)[(b)]	<0.001	0.12	0.0064	<0.001	0.12	0.0087	NA	1.4	1.3
TRU Wastes	NA	NA	NA	0.043	0.043	0.043	NA	0.16	0.16
Total	<0.001	0.12	0.0064	0.29	0.41	0.3	NA	4.0	3.9
Hanford to Offsite									
MLLW to ORR/Comm Treat[(b)]	<0.001	0.12	0.0064	<0.001	0.12	0.0064	NA	0.12	0.0064
TRU Wastes to WIPP	1.8	5.0	5.0	1.8	5.0	5.0	NA	5.2	5.2
Total	1.8	5.1	5.0	1.8	5.1	5.0	NA	5.3	5.2
GRAND TOTAL	2 (1.9)	5 (5.4)	6 (5.9)	2 (2.2)	6 (5.8)	6 (6.2)	NA	10 (9.5)	10 (10.0)

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) These values are the sums of the potential LCFs from incident-free radiological exposures, probability-weighted radiological accident risks, and incident-free non-radiological emissions.

(b) These data include MLLW that is assumed to be shipped to ORR or an offsite commercial treatment facility (comm treat) for treatment and then returned to Hanford for disposal. The Lower Bound waste volume includes a small quantity of MLLW to be shipped to Hanford for disposal and the Upper Bound waste volume includes shipment of a much larger quantity of MLLW to Hanford for disposal.

NA = not applicable.

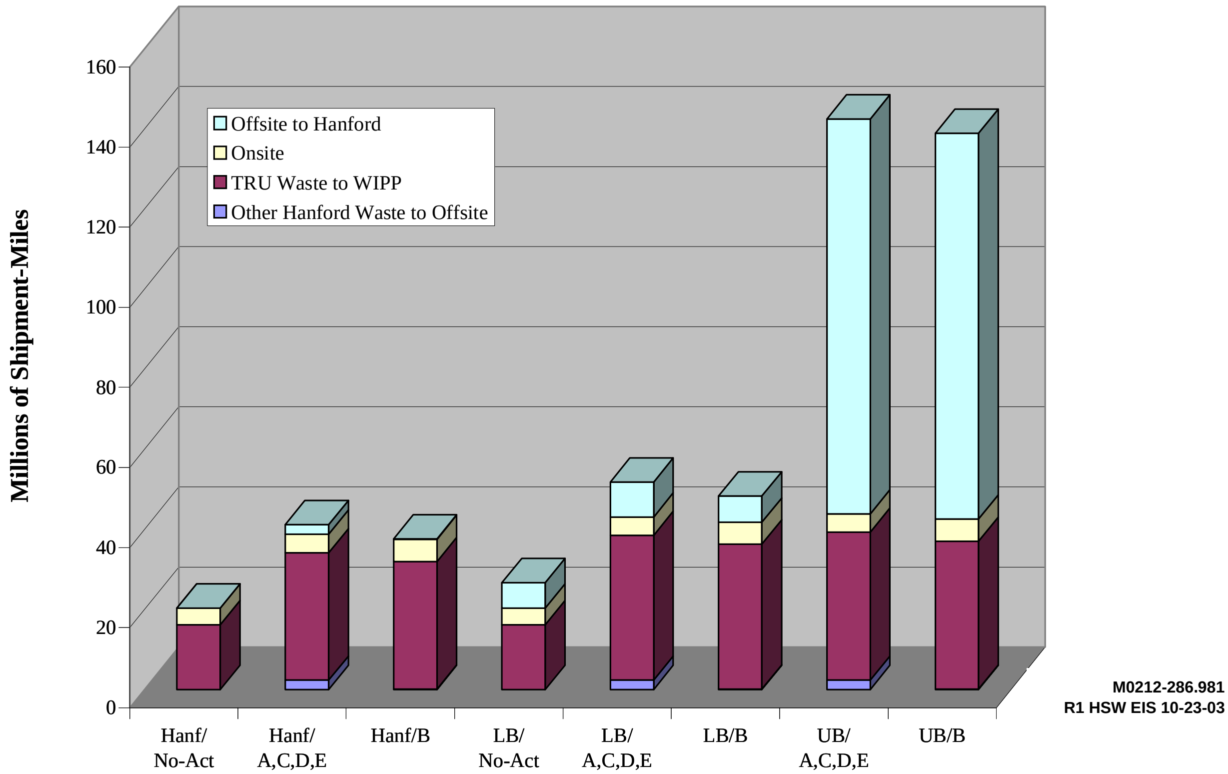
Table H.24. Non-Radiological Accident Impacts by Shipment Origin and Waste Type

	Hanford Only Waste Volume			Lower Bound Waste Volume			Upper Bound Waste Volume		
	No Action Alternative	Alternative Groups		No Action Alternative	Alternative Groups		No Action Alternative	Alternative Groups	
		A,C,D, E	B		A,C,D,E	B		A,C,D,E	B
Onsite Shipments									
LLW	0.03	0.031	0.031	0.03	0.031	0.031	NA	0.031	0.031
MLLW (including melters)	0.015	0.018	0.0087	0.015	0.018	0.0087	NA	0.018	0.0087
TRU Wastes	0.0047	0.0039	0.0039	0.0047	0.0039	0.0039	NA	0.0039	0.0039
ILAW	0	0.0023	0.023	0	0.0023	0.023	NA	0.0023	0.023
Total	0.05	0.055	0.067	0.05	0.055	0.067	NA	0.055	0.067
Offsite Shipments to Hanford									
LLW	NA	NA	NA	0.11	0.11	0.11	NA	1.1	1.1
MLLW (includes MLLW from ORR/Comm Treat and offsite) [(a)]	<0.0001	0.015	0.00081	<0.0001	0.016	0.0016	NA	0.66	0.65
TRU Wastes	NA	NA	NA	0.0032	0.0032	0.0032	NA	0.014	0.014
Total	<0.0001	0.015	0.00081	0.11	0.13	0.12	NA	1.8	1.7
Hanford to Offsite									
MLLW to ORR/Comm Treat[(a)]	<0.0001	0.015	0.00081	<0.001	0.015	0.00081	NA	0.015	0.00081
TRU Wastes to WIPP	0.28	0.54	0.54	0.28	0.55	0.55	NA	0.56	0.56
Total	0.28	0.56	0.54	0.28	0.56	0.55	NA	0.58	0.56
GRAND TOTAL	0 (0.33)	1 (0.63)	1 (0.61)	0 (0.44)	1 (0.75)	1 (0.73)	NA	2 (2.4)	2 (2.4)

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) These data include MLLW that is assumed to be shipped to ORR or an offsite commercial treatment facilities (comm treat) for treatment and then returned to Hanford for disposal. The Lower Bound waste volume includes a small quantity of MLLW shipped to Hanford for disposal and the Upper Bound waste volume includes shipment of a much larger quantity of MLLW to Hanford for disposal.

NA = not applicable.



Hanf = Hanford Only waste volume
No Act = No Action Alternative
UB = Upper Bound
LB = Lower Bound
A,C,D,E = Alternative Groups A, C, D, and E
B = Alternative Group B

Figure H.2. Shipment-Miles for Onsite and Offsite Waste Shipments

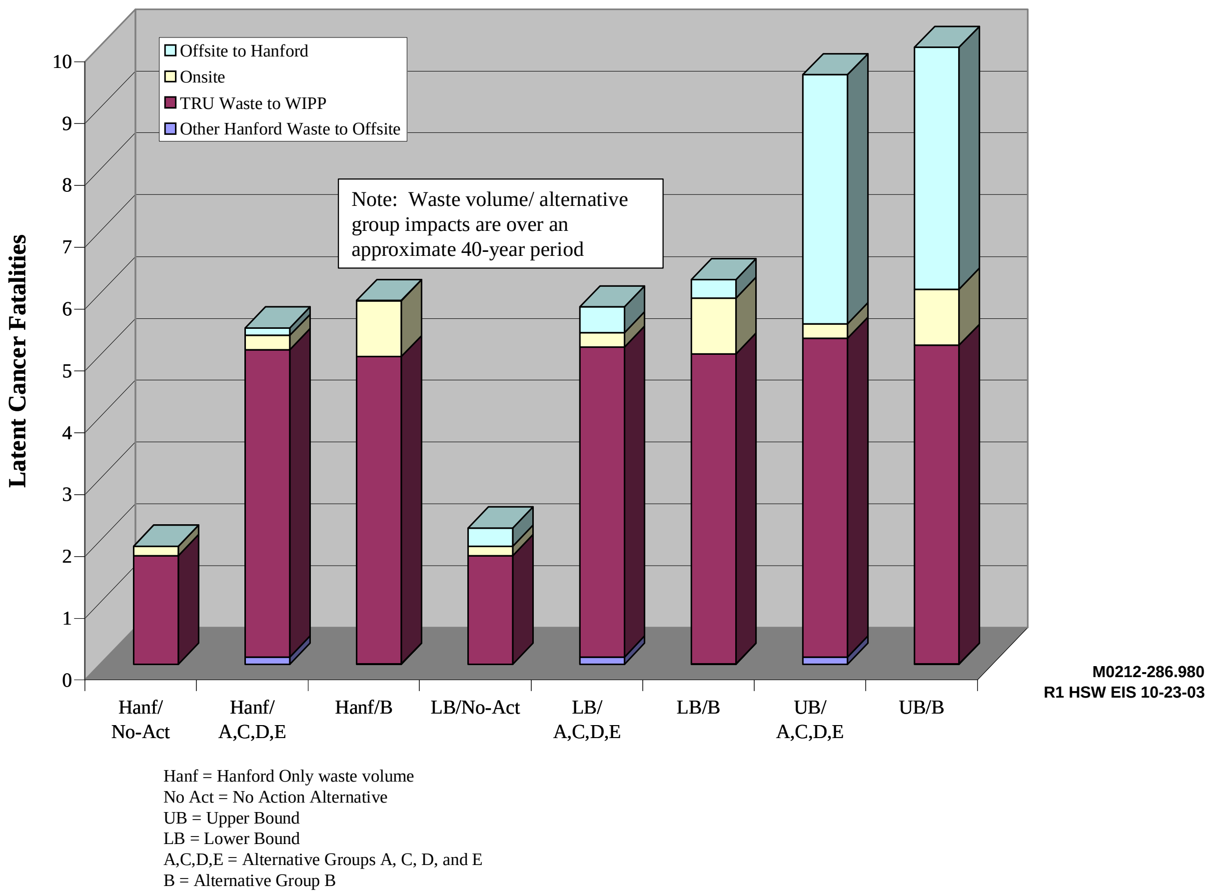


Figure H.3. Potential Transportation Impacts of Onsite and Offsite Waste Shipments—LCFs from Radiological Incident-Free Transport, Radiological Accidents, and Non-Radiological Emissions(a)

(a) Although fatalities should be expressed as whole numbers, fractional fatalities are presented to facilitate illustration. Elsewhere fractional fatalities of 0.5 and greater are rounded up to the next whole number.

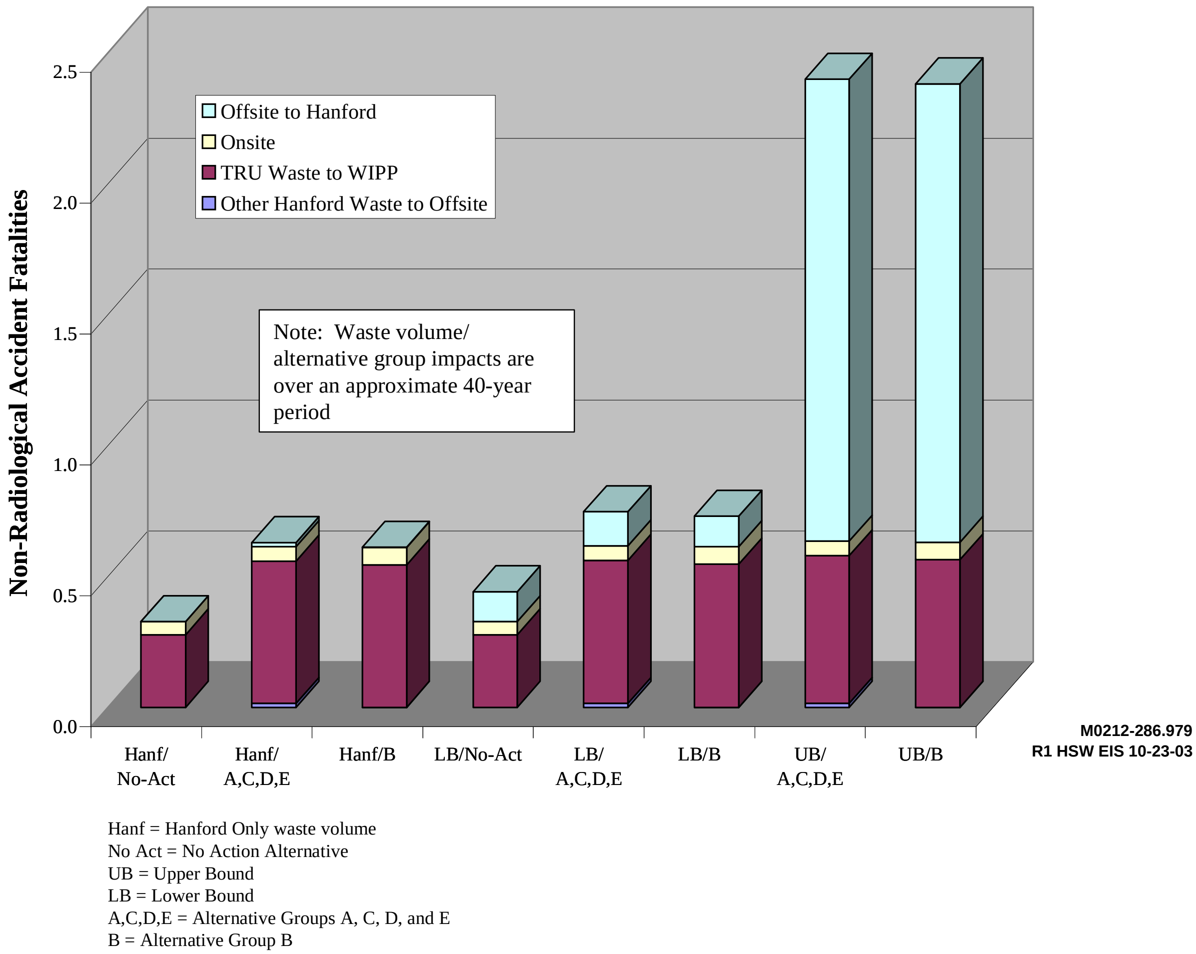


Figure H.4. Potential Transportation Impacts of Onsite and Offsite Waste Shipments—Non-Radiological Fatalities from Traffic Accidents[(a)]

H.3.3.2 Sensitivity Studies

This section presents the results of two sensitivity studies that were conducted to examine the effects on transportation impacts of alternative offsite TRU waste generators. The first study examines the effects of shifting a portion of the Upper Bound offsite TRU waste volume from the Western United States to the Eastern United States. The intent is to demonstrate the effects of increased TRU waste shipping distances on the transportation impact estimates for shipping TRU wastes to Hanford under the Upper Bound waste volume. The second sensitivity study examines the effects of receiving additional TRU wastes from West Valley, New York, on the transportation impacts estimates for the Upper Bound waste volume.

(a) Although fatalities should be expressed as whole numbers, fractional fatalities are presented to facilitate illustration. Elsewhere fractional fatalities of 0.5 and greater are rounded up to the next whole number.

H.3.3.2.1 Effects of Shifting some TRU Wastes Receipts from the Western United States to the Eastern United States

Because there is uncertainty about the generators that might ship TRU wastes to Hanford, a sensitivity study was conducted. This study examined the effects of shifting some TRU waste shipments from California to longer, cross-country shipments. It was assumed that 470 m^3 of CH TRU waste and 5 m^3 of RH TRU waste would be shifted from the Lawrence Livermore National Laboratory (LLNL) in California to the Separations Process Research Unit (SPRU) in New York. This would increase the overall shipping distance, yet maintain the total volume of TRU wastes from offsite at about 1550 m^3.

The results of this sensitivity study are shown in Table H.25. As shown, when compared to the base case (see Tables H.17 and H.19), the longer shipping distances increase the impacts. The impacts most strongly dependent on shipping distance—that is, worker (truck crew) incident-free radiological impacts and non-radiological accident fatalities—increase substantially. Those impacts less dependent on total miles traveled (for example, public radiological incident-free impacts and non-radiological emissions are influenced by both mileage and population density) increase by lesser amounts. The non-radiological emissions impacts did not change, which indicates that the affected population in urban zones is higher for the LLNL to Hanford shipments than for the SPRU to Hanford (see Table H.7). However, shifting some TRU wastes from LLNL to SPRU did not result in either a radiological or non-radiological fatality.

Table H.25. Results of Sensitivity Study (Fatalities) for Shifting TRU Waste Shipments from California to New York[(a)]

	Radiological Impacts			Total Number of Accidents	Non-Radiological Impacts	
	Incident-Free LCFs		Accident Public		Number of Fatalities	Emissions LCFs
	Worker	Public				
Base Case						
CH TRU waste	3.8E-03	5.1E-02	2.4E-05	1.3E-01	8.2E-03	2.1E-02
RH TRU waste	2.4E-03	7.4E-02	1.4E-05	1.1E-01	5.4E-03	1.0E-02
Total	6.2E-03	1.3E-01	3.7E-05	2.4E-01	1.4E-02	3.1E-02
Sensitivity Case						
CH TRU waste	5.8E-03	5.0E-02	2.4E-04	2.7E-01	1.2E-02	2.1E-02
RH TRU waste	2.6E-03	7.4E-02	3.5E-05	1.3E-01	5.7E-03	1.0E-02
Total	8.4E-03	1.2E-01	2.7E-04	4.0E-01	1.7E-02	3.1E-02

Note: Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

H.3.3.2.2 Potential Incremental Transportation Impacts if West Valley TRU Wastes Were to be Shipped to Hanford

The *West Valley Demonstration Project Waste Management Environmental Impact Statement* (WV EIS) (DOE 2003) describes the environmental impacts of DOE's proposed action to ship radioactive wastes that are either currently in storage, or that will be generated from operations over the next 10 years, from the West Valley Site to offsite disposal locations and to continue ongoing waste management activities at the site. Under DOE's preferred alternative, LLW and MLLW would be shipped to Hanford or the Nevada Test Site for disposal, and TRU wastes would be shipped to WIPP for disposal. DOE's non-preferred alternative is the same as the preferred alternative with respect to LLW and MLLW. However, under DOE's non-preferred alternative, TRU wastes could be sent to Hanford, or other large DOE sites, for interim storage until those wastes could be shipped to WIPP. Although shipment of TRU wastes to Hanford is not the preferred alternative in the WV EIS, an analysis was conducted to examine the potential incremental transportation impacts of shipping West Valley TRU waste to Hanford.

Shipments of TRU wastes to Hanford from West Valley were not addressed in the draft or revised draft HSW EIS analyses because such shipments would not be consistent with the RODs for the WM PEIS (DOE 1997a; 63 FR 3629; 65 FR 82985; 66 FR 38646; 67 FR 56989) or the WIPP SEIS-II (DOE 1997b; 63 FR 3623). In addition, shipments of TRU waste from West Valley were not considered as part of the DOE national TRU waste performance management plan (DOE 2002d). The latter document considered shipment of CH TRU waste from West Valley to an "eastern hub" located at the Savannah River Site (SRS) and then on to WIPP. For RH TRU waste, DOE (2002d) is less specific, stating that RH TRU waste would be shipped to a hub site or existing facilities at RH TRU waste sites for characterization and certification. Shipments of West Valley LLW and MLLW to Hanford were included in the HSW EIS Upper Bound waste volumes; however, the LLW and MLLW volumes in the WV EIS are somewhat larger than those considered in the HSW EIS. As stated elsewhere in the HSW EIS, treatment and disposal of solid wastes at Hanford will be managed in accordance with the total waste volumes and not by generator. For all waste types, the waste volumes that could potentially be received at Hanford from West Valley are small relative to the total waste volumes considered in the HSW EIS. Consequently, inclusion of additional WV EIS waste volumes in the HSW EIS would not affect the impacts at Hanford or decisions to be made about solid waste management at Hanford.

The transportation impact analysis for the West Valley TRU waste shipments was conducted using methods and data that are consistent with those used in the HSW EIS so the incremental impacts are comparable to the impacts presented elsewhere in the HSW EIS. In general, the methods and data used in the WV EIS are similar to those used in the HSW EIS. For example, the RADTRAN 5 and TRAGIS computer codes were used in both documents. However, there are some differences (see below) that could affect comparisons of the impacts, so the HSW EIS assumptions and data were used to recalculate the impacts so they can be directly compared to the other transportation impacts presented in this HSW EIS. This analysis includes shipments of the additional TRU waste from West Valley to Hanford and shipments of those wastes from Hanford to WIPP.

The important differences in the data and assumptions used to calculate transportation impacts between the HSW EIS and WV EIS are discussed below. Many of the data and assumptions are the same or similar, such as the dose rates used for CH TRU and RH TRU waste shipments, CH TRU waste container capacity, route characteristics, accident rates, and release fractions.

Shipping containers. The TRUPACT-II shipping container used for CH TRU waste was assumed to be the same in both the WV EIS and HSW EIS. Consequently, the numbers of CH TRU waste shipments are comparable. However, the RH TRU waste shipping container assumed in the WV EIS is approximately two times the volume of the shipping containers assumed in the HSW EIS, so the number of shipments of RH TRU waste projected in the HSW EIS would be about twice that estimated in the WV EIS. This increased number of shipments resulted in larger transportation impact estimates for RH TRU waste in the HSW EIS than in the WV EIS.

Radionuclide inventories. Radionuclide inventories are used in the estimation of radiological accident impacts. The HSW EIS and WV EIS used CH TRU waste inventories from the WIPP SEIS-II (DOE 1997b). The radiological accident impacts associated with the CH TRU shipments are approximately the same. The RH TRU waste inventories used in the WV EIS were determined by scaling spent nuclear fuel radionuclide distributions to shipping container limits and are lower than those used in the HSW EIS. As a result, the radiological accident impacts presented in the WV EIS for RH TRU waste shipments are not directly comparable to those presented in the HSW EIS. However, since radiological accident impacts are small relative to incident-free and non-radiological emissions impacts, these differences would not affect the total transportation impacts.

Radiation doses at truck stops. Incident-free radiological doses at truck stops are a function of the time spent at truck stops for food, refueling, etc.; the number of people at the stop; and the dose rate to which people are exposed. The approaches that were used to calculate doses at truck stops in the WV EIS and HSW EIS were different. The WV EIS used stop dose factors that were developed for the Yucca Mountain EIS (DOE 2002b). The HSW EIS used the TRAGIS code to estimate stop times for all shipments. Default values were used to model the number of people exposed at stops and the average exposure distance (50 people at 20 m from the shipment). Application of the latter approach resulted in higher "stop" doses in the HSW EIS than in the WV EIS.

Conditional probabilities of accidental releases. The HSW EIS used conditional probabilities of accidental releases that were derived in NRC (1977). In the WV EIS, the conditional probabilities were derived by combining data in NRC (1977) with two reassessments (Fischer et al. 1987a, 1987b; Sprung et al. 2000). Since the reassessments focused on spent nuclear fuel and not the diverse waste materials and forms represented by TRU wastes at various DOE sites, it was decided that the HSW EIS would use bounding values developed in support of NRC (1977). The values used in the HSW EIS resulted in higher radiological accident impacts than those presented in the WV EIS.

Health effects conversion factors. The factors that were used to convert radiation dose estimates in person-rem to health effects (LCFs) were slightly different. In the HSW EIS, the factor used was 6E-04 LCFs per person-rem for both the general public and workers. The

WV EIS used 6E-04 LCFs per person-rem for the general public and 5E-04 LCFs per person-rem for workers. This would result in higher potential impacts to workers in the HSW EIS than the WV EIS.

Since some of the data and assumptions result in higher impact estimates for the HSW EIS and some result in higher estimates for the WV EIS, these data and assumptions offset each other. Overall, the HSW EIS is consistently more conservative than the WV EIS, with the possible exception of radiological accidents involving RH TRU waste, which has little effect on the overall potential transportation impacts. However, because of the differences discussed above, potential impacts from the shipments of West Valley TRU waste to Hanford presented in this section were prepared consistent with the HSW EIS data and assumptions to ensure the results of this analysis are comparable to other results presented in this HSW EIS.

The WV EIS evaluates shipment of about 1130 m^3 (40,000 ft^3) of CH TRU waste and 250 m^3 (9,000 ft^3) of RH TRU waste to Hanford. This amounts to 152 shipments of CH TRU waste and 287 shipments of RH TRU waste for the HSW EIS sensitivity analysis. This is approximately the same number of CH TRU waste shipments and twice the number of RH TRU waste shipments evaluated in the WV EIS (recall that the RH TRU waste shipping container used in the WV EIS has about twice the capacity of the shipping container used in the HSW EIS, so there would be about half as many shipments). The incremental impacts of these shipments are presented in Table H.26, which presents the shipment of TRU waste from West Valley to Hanford and shipment of the same quantity of TRU waste from Hanford to WIPP.

Table H.26. Potential Incremental Transportation Impacts if West Valley TRU Waste were to be Shipped to Hanford

Waste Type	Radiological Impacts, LCFs			Total Number of Accidents	Non-Radiological Impacts	
	Incident-Free: Workers	Incident-Free: Public	Accidents		Number of Fatalities	Emissions LCFs
West Valley TRU Waste to Hanford						
CH TRU Waste	0.0067	0.061	<0.001	0.39	0.013	0.013
RH TRU Waste	0.012	0.29	<0.001	0.74	0.024	0.025
Total	0 (0.019)	0 (0.35)	0 (<0.001)	1 (1.1)	0 (0.037)	0 (0.038)
West Valley TRU Waste from Hanford to WIPP						
CH TRU Waste	0.0055	0.053	<0.001	0.31	0.01	0.006
RH TRU Waste	0.0098	0.25	<0.001	0.58	0.019	0.011
Total	0 (0.015)	0 (0.3)	0 (<0.001)	1 (0.89)	0 (0.029)	0 (0.017)
Grand Total – All Shipments	0 (0.034)	1 (0.65)	0 (<0.001)	2 (2.0)	0 (0.066)	0 (0.055)

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

Table H.27 presents the potential impacts (that is, shipment-miles, LCFs, and non-radiological accident fatalities) for the HSW EIS Upper Bound waste volume and the HSW EIS Upper Bound waste volume plus the West Valley TRU waste shipments. Also presented are the percentage increases in potential impacts that would result from including the West Valley TRU waste in the HSW EIS analyses. Table H.27 indicates that total shipment-miles would increase by about 3 percent above the HSW EIS Upper Bound waste volume assumptions. This increased mileage results in a 3 percent increase in estimated non-radiological accident fatalities. The additional shipments of TRU waste from West Valley would increase the potential LCFs by about 8 percent. The percentage increase in LCFs is higher than the increase in non-radiological accident fatalities because of the higher assumed dose rates for TRU waste shipments than for LLW and MLLW. Thus radiological impacts from incident-free transport are more strongly influenced by the additional shipments than shipment-mileage and non-radiological accident fatality estimates. In either event, the potential transportation impacts of the additional West Valley TRU waste shipments represent a small fraction of the total transportation impacts estimated for the HSW EIS Upper Bound waste volume.

In addition, regardless of whether the West Valley TRU waste is shipped directly to WIPP or via a hub site, there would be potential transportation impacts. Based on the results presented in the WV EIS, the incremental increase in transportation impacts for shipping via a potential eastern hub at Savannah River or a potential western hub at Hanford would be about 15 to 70 percent, respectively.

Table H.27. Total Potential HSW Transportation Impacts With and Without West Valley TRU Waste Shipments

Scenario	Upper Bound Waste Volume Action Alternatives A,C,D,E	Upper Bound Waste Volume Action Alternatives B
Millions of Shipment Miles		
Onsite	4.6	5.5
Offsite shipments to Hanford	98.5	96.3
Offsite shipments from Hanford	2.4	0.1
Total HSW EIS Upper Bound waste volume without West Valley TRU waste	105.5	102.0
West Valley TRU waste to Hanford	2.3	2.3
West Valley TRU waste/Hanford to WIPP	0.6	0.6
Total HSW EIS Upper Bound waste volume with West Valley TRU waste	108.3	104.8
% increase due to West Valley TRU waste	3%	3%
Latent Cancer Fatalities[(a)]		
Onsite	0 (0.23)	1 (0.9)
Offsite shipments to Hanford	4 (4.0)	4 (3.9)
Offsite shipments from Hanford	5 (5.3)	5 (5.2)
Total HSW EIS Upper Bound waste volume without West Valley TRU waste	10 (9.5)	10 (10.0)
West Valley TRU waste to Hanford	0 (0.41)	0 (0.41)
West Valley TRU waste/Hanford to WIPP	0 (0.33)	0 (0.33)
Total HSW EIS Upper Bound waste volume with West Valley TRU waste	10 (10.3)	11 (10.7)
% increase due to West Valley TRU waste	8%	7%
Non-Radiological Accident Fatalities		
Onsite	0 (0.055)	0 (0.067)
Offsite shipments to Hanford	2 (1.8)	2 (1.7)
Offsite shipments from Hanford	1 (0.58)	1 (0.56)
Total HSW EIS Upper Bound waste volume without West Valley TRU waste	2 (2.4)	2 (2.4)
West Valley TRU waste to Hanford	0 (0.037)	0 (0.037)
West Valley TRU waste/Hanford to WIPP	0 (0.029)	0 (0.029)
Total HSW EIS Upper Bound waste volume with West Valley TRU waste	3 (2.5)	2 (2.4)
% increase due to West Valley TRU waste	3%	3%

Note: Totals are rounded to one significant figure. Due to rounding, the sums of the numbers in the table may not exactly match the totals.

(a) LCFs = Latent cancer fatalities. Includes radiological incident-free impacts to workers and the public, radiological accident impacts, and non-radiological emissions impacts.

H.4 Impacts of Transporting Construction and Capping Materials

This section evaluates the impacts of transporting materials required to construct new facilities, such as new disposal trenches and treatment facilities, as well as materials required to cap the disposal facilities after they are filled with waste. The quantities of these materials, which include concrete, asphalt, basalt, and steel, are compiled for each alternative group in Volume I, Section 5.10. This section evaluates the impacts of transporting these materials from their points of origin to the appropriate Hanford Site facility. Note that only the non-radiological impacts of transportation accidents are evaluated. No radiological impacts would occur because the shipments of construction and capping materials would not involve radioactive material.

The non-radiological accident impacts of transporting construction materials were estimated by first determining the numbers of shipments of each type of material. This calculation was done by dividing the total material requirements by the capacity of a typical shipment. Typically, the shipment capacities are limited to about 18,140 kg (40,000 lb) of cargo to ensure that the shipments are below legal-weight truck limits (36,290 kg [80,000 lb] gross vehicle-weight in most states). The next step was to determine the total distance traveled by these shipments or the product of the round-trip shipping distance and the number of shipments. Finally, the projected numbers of fatalities were determined by multiplying the travel distances by the accident and fatality rates for heavy-combination truck shipping. The accident rate used in this analysis was 1.75E-07 accidents per truck-kilometer (2.8E-07 accidents per truck-mile), and the fatality rate was 7.5E-09 fatalities per truck-kilometer (1.2E-08 fatalities per truck-mile). These rates are representative of accident and fatality rates on Washington state primary highways, similar to the highways and roadways to be used for most of the shipments. The rates used in this analysis were taken from Saricks and Tompkins (1999).

Table H.28 presents the input data and results of the impact analysis for the transport of construction and capping materials. The table includes the estimated impacts associated with each alternative group and waste volume. Although accidents are expected to occur, in no case were any fatalities projected to occur associated with the transport of construction and capping materials.

The results in Table H.28 indicate that there are not large differences in impacts among the alternative groups. For the Hanford Only waste volumes, the projected fatalities ranged from about 0.06 for Alternative Groups C, D, and E to 0.15 fatalities for the No Action Alternative. The impacts of all alternative groups except for the No Action Alternative are dominated by transport of asphalt, gravel/sand, silt/loam, and basalt, and bentonite to use as capping materials. The impacts for the No Action Alternative are dominated by the transport of steel and concrete.

Table H.28. Impacts of Transporting Construction and Backfill Materials

Alternative Group	Waste Volume	Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Total Number of Accidents	Number of Fatalities
A	**Hanford Only**								
	Asphalt (1000 m^3)	392	12 m^3	32,667	Offsite	45	2.9E+06	5.1E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,394	20 m^3	119,700	Area C	15	3.6E+06	6.3E-01	2.7E-02
	Steel (MT)	1,720	10 MT	172	Unspecified	1,000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	831	Offsite	45	7.5E+04	1.3E-02	5.6E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						8.4E+06	1.5	6.3E-02
	Lower Bound								
	Asphalt (1000 m^3)	394	12 m^3	32,833	Offsite	45	3.0E+06	5.2E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,405	20 m^3	120,250	Area C	15	3.6E+06	6.3E-01	2.7E-02
	Steel (MT)	1,870	10 MT	187	Unspecified	1,000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	991	Offsite	45	8.9E+04	1.6E-02	6.7E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						8.5E+06	1.5	6.4E-02
	Upper Bound								
	Asphalt (1000 m^3)	416	12 m^3	34,667	Offsite	45	3.1E+06	5.5E-01	2.3E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,500	20 m^3	125,000	Area C	15	3.8E+06	6.6E-01	2.8E-02
	Steel (MT)	2,280	10 MT	228	Unspecified	1,000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1,431	Offsite	45	1.3E+05	2.3E-02	9.7E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1,000	1.9E+06	3.4E-01	1.4E-02
	Total						9.4E+06	1.6	7.0E-02
B	**Hanford Only**								
	Asphalt (1000 m^3)	438	12 m^3	36,500	Offsite	45	3.3E+06	5.7E-01	2.5E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,552	20 m^3	127,600	Area C	15	3.8E+06	6.7E-01	2.9E-02
	Steel (MT)	1,800	10 MT	180	Unspecified	1,000	3.6E+05	6.3E-02	2.7E-03
	Concrete (1000 m^3)	10	10 m^3	1,021	Offsite	45	9.2E+04	1.6E-02	6.9E-04
	Bentonite (MT)	33,600	19 MT	1,768	Wyoming	1,000	3.5E+06	6.2E-01	2.7E-02
	Total						1.1E+07	1.9	8.3E-02
	Lower Bound								
	Asphalt (1000 m^3)	444	12 m^3	37,000	Offsite	45	3.3E+06	5.8E-01	2.5E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,593	20 m^3	129,650	Area C	15	3.9E+06	6.8E-01	2.9E-02
	Steel (MT)	1,950	10 MT	195	Unspecified	1,000	3.9E+05	6.8E-02	2.9E-03
	Concrete (1000 m^3)	12	10 m^3	1,231	Offsite	45	1.1E+05	1.9E-02	8.3E-04
	Bentonite (MT)	33,600	19 MT	1,768	Wyoming	1,000	3.5E+06	6.2E-01	2.7E-02
	Total						1.1E+07	2.0	8.4E-02
	Upper Bound								
	Asphalt (1000 m^3)	498	12 m^3	41,500	Offsite	45	3.7E+06	6.5E-01	2.8E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,827	20 m^3	141,350	Area C	15	4.2E+06	7.4E-01	3.2E-02
	Steel (MT)	2,380	10 MT	238	Unspecified	1,000	4.8E+05	8.3E-02	3.6E-03
	Concrete (1000 m^3)	16	10 m^3	1,631	Offsite	45	1.5E+05	2.6E-02	1.1E-03
	Bentonite (MT)	57,600	19 MT	3,032	Wyoming	1,000	6.1E+06	1.1	4.5E-02
	Total						1.5E+07	2.6	1.1E-01

Table H.28. (contd)

Alternative Group	Waste Volume	Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Total Number of Accidents	Number of Fatalities
C	**Hanford Only**								
	Asphalt (1000 m^3)	372	12 m^3	31,000	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,174	20 m^3	108,700	Area C	15	3.3E+06	5.7E-01	2.4E-02
	Steel (MT)	1,720	10 MT	172	Unspecified	1,000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	800	Offsite	45	7.2E+04	1.3E-02	5.4E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						7.9E+06	1.4	5.9E-02
	Lower Bound								
	Asphalt (1000 m^3)	374	12 m^3	31,167	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,185	20 m^3	109,250	Area C	15	3.3E+06	5.7E-01	2.5E-02
	Steel (MT)	1,870	10 MT	187	Unspecified	1,000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	960	Offsite	45	8.6E+04	1.5E-02	6.5E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						8.0E+06	1.4	6.0E-02
	Upper Bound								
	Asphalt (1000 m^3)	396	12 m^3	33,000	Offsite	45	3.0E+06	5.2E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,280	20 m^3	114,000	Area C	15	3.4E+06	6.0E-01	2.6E-02
	Steel (MT)	2,280	10 MT	228	Unspecified	1,000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1,400	Offsite	45	1.3E+05	2.2E-02	9.5E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1,000	1.9E+06	3.4E-01	1.4E-02
	Total						8.9E+06	1.6	6.7E-02
D	**Hanford Only**								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,174	20 m^3	108,700	Area C	15	3.3E+06	5.7E-01	2.4E-02
	Steel (MT)	1,710	10 MT	171	Unspecified	1,000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	800	Offsite	45	7.2E+04	1.3E-02	5.4E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						7.9E+06	1.4	5.9E-02
	Lower Bound								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,204	20 m^3	110,200	Area C	15	3.3E+06	5.8E-01	2.5E-02
	Steel (MT)	1,870	10 MT	187	Unspecified	1,000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	990	Offsite	45	8.9E+04	1.6E-02	6.7E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						8.0E+06	1.4	6.0E-02
	Upper Bound								
	Asphalt (1000 m^3)	383	12 m^3	31,917	Offsite	45	2.9E+06	5.0E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,331	20 m^3	116,550	Area C	15	3.5E+06	6.1E-01	2.6E-02
	Steel (MT)	2,280	10 MT	228	Unspecified	1,000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1,400	Offsite	45	1.3E+05	2.2E-02	9.5E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1,000	1.9E+06	3.4E-01	1.4E-02
	Total						8.9E+06	1.6	6.7E-02

Table H.28. (contd)

Alternative Group	Waste Volume	Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Total Number of Accidents	Number of Fatalities
E	**Hanford Only**								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,174	20 m^3	108,700	Area C	15	3.3E+06	5.7E-01	2.4E-02
	Steel (MT)	1,710	10 MT	171	Unspecified	1,000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	800	Offsite	45	7.2E+04	1.3E-02	5.4E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						7.9E+06	1.4	5.9E-02
	Lower Bound								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,185	20 m^3	109,250	Area C	15	3.3E+06	5.7E-01	2.5E-02
	Steel (MT)	1,870	10 MT	187	Unspecified	1,000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	990	Offsite	45	8.9E+04	1.6E-02	6.7E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1,000	1.5E+06	2.6E-01	1.1E-02
	Total						8.0E+06	1.4	6.0E-02
	Upper Bound								
	Asphalt (1000 m^3)	383	12 m^3	31,917	Offsite	45	2.9E+06	5.0E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,280	20 m^3	114,000	Area C	15	3.4E+06	6.0E-01	2.6E-02
	Steel (MT)	2,280	10 MT	228	Unspecified	1,000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1,400	Offsite	45	1.3E+05	2.2E-02	9.5E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1,000	1.9E+06	3.4E-01	1.4E-02
	Total						8.8E+06	1.5	6.6E-02
No Action	**Hanford Only**								
	Asphalt (1000 m^3)	35	12 m^3	2,933	Offsite	45	2.6E+05	4.6E-02	2.0E-03
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,648	20 m^3	132,405	Area C	15	4.0E+06	7.0E-01	3.0E-02
	Steel (MT)	59,100	10 MT	5,910	Unspecified	1,000	1.2E+07	2.01	8.9E-02
	Concrete (1000 m^3)	420	10 m^3	42,000	Offsite	45	3.8E+06	6.6E-01	2.8E-02
	Bentonite (MT)	0	19 MT	0	Wyoming	1,000	0	0	0
	Total						2.0E+07	3.5	1.5E-01
	Lower Bound								
	Asphalt (1000 m^3)	35	12 m^3	2,933	Offsite	45	2.6E+05	4.6E-02	2.0E-03
	Gravel/sand, silt/loam, basalt (1000 m^3)	2,648	20 m^3	132,405	Area C	15	4.0E+06	7.0E-01	3.0E-02
	Steel (MT)	59,200	10 MT	5,920	Unspecified	1,000	1.2E+07	2.1	8.9E-02
	Concrete (1000 m^3)	422	10 m^3	42,200	Offsite	45	3.8E+06	6.6E-01	2.8E-02
	Bentonite (MT)	0	19 MT	0	Wyoming	1,000	0	0	0
	Total						2.0E+07	3.5	1.5E-01

H.5 Impacts on Traffic

The potential for adverse impacts on traffic would be limited to those associated with the transport of construction materials from offsite, which would be predominantly along 4- to 6-lane highways south of the Hanford Site; traffic congestion would not be expected. The transport of the majority of capping resources would be onsite as material from Area C likely would be delivered under State Route (SR) 240 by conveyors to a holding area in Area B on the Hanford Site east of SR 240. However, for a conservative view, the transportation-impact analysis assumed that all transport of capping material would be by truck.

H.6 Transportation Impacts of Offsite Shipments Within Washington and Oregon

This section estimates the potential impacts within the states of Washington and Oregon of offsite transportation of solid wastes to and from Hanford. Included are the impacts of transporting LLW, MLLW, and TRU wastes from offsite to Hanford Site treatment and disposal facilities; the impacts of transporting MLLW from Hanford to offsite commercial disposal facilities; and the impacts of transporting TRU wastes to WIPP.

H.6.1 Radiological Incident-Free Exposure and Accident Impact Analysis Parameters

The RADTRAN 5 computer code (Neuhauser et al. 2003) was used to perform the transportation-impact calculations. For offsite shipments, the key differences in RADTRAN 5 parameters are primarily related to the route characteristics (for example, shipping distances; travel fractions; and population densities in rural, suburban, and urban population zones). For the purposes of this HSW EIS, three actual routes through Oregon and Washington are assumed (see Figure H.5). The first enters Oregon at approximately Ashland, Oregon, on Interstate 5 (I-5) and travels north to Portland, Oregon. Near Portland, the shipment takes I-205 to I-84 and then travels up the Columbia River Gorge to Umatilla, Oregon. Near Umatilla, shipments exit I-84 onto I-82, cross into the state of Washington, and travel to Richland, Washington. Near Richland, shipments exit onto SR 240 and travels to the Hanford Site. The second route enters the state of Oregon near Ontario, Oregon, on I-84 and continues to Umatilla, Oregon, where it follows I-82 and the same path to Hanford described for the first route. Note that both routes enter the state of Washington at the Umatilla, Oregon/Plymouth, Washington ports of entry. The third route follows I-90 and I-82. This route could be used to transport a small volume (about 3 m^3) of MLLW from the Puget Sound Naval Shipyard to the Hanford Site. Because of the small volume of waste and activity contained therein, the potential impacts along this route would contribute negligibly to potential transportation impacts forecast for the state of Washington along the principal route.

The TRAGIS computer code (Johnson and Michelhaugh 2000) was used to develop the route characteristics information for the RADTRAN 5 runs. A summary of the route characteristics for transport within Washington and Oregon are shown in Table H.29.

Table H.30 summarizes the LLW, MLLW, and TRU wastes volumes that may be transported from offsite to Hanford under the Lower Bound and Upper Bound waste volume scenarios and the TRU waste volume that would be transported from Hanford to WIPP.

For comparison purposes, the remaining RADTRAN 5 parameters were assumed to be the same as for onsite shipments. This is a realistic assumption because the shipping containers for onsite shipments are required to meet equivalent packaging and transportation standards as shipping containers for offsite shipments. The incident-free exposure parameters used in the RADTRAN 5 calculations were presented previously in Table H.1. Note that route-specific estimates of stop time were used in the calculations.

Figure H.5. Transportation Routes in Washington and Oregon

Table H.29. Route Characteristics for Transport Within Washington and Oregon

Route Description	Distance, km	Distance by Zone (km)			Population Density, per sq. km		
		Rural	Suburban	Urban	Rural	Suburban	Urban
Enter OR at Ashland	825	557.2	214.0	53.6	10.6	366.8	2402.5
Enter OR at Ontario	425	366.2	49.2	9.6	6.5	411.4	2190.1

Table H.30. Offsite Shipping Volumes Used for Oregon and Washington Impacts Calculations

Waste Type	Route, via	Number of Shipments
Lower Bound Waste Volume		
Shipments to Hanford		
LLW	Ontario	1,297
	Ashland	166
MLLW	Ontario	10
	Ashland	0
CH TRU waste	Ontario	1
	Ashland	1
RH TRU waste	Ontario	29
	Ashland	17
Shipments from Hanford to WIPP (Ontario)		
CH TRU waste	Ontario	5,221
RH TRU waste	Ontario	2,986
Total Lower Bound Shipments		
	Ontario	9,544
	Ashland	184
Upper Bound Waste Volume		
Shipments to Hanford		
LLW	Ontario	14,436
	Ashland	943
MLLW	Ontario	9,732
	Ashland	96
CH TRU waste	Ontario	171
	Ashland	26
RH TRU waste	Ontario	39
	Ashland	74
Shipments from Hanford to WIPP (Ontario)		
CH TRU waste	Ontario	5,415
RH TRU waste	Ontario	3,052
Total Upper Bound Shipments		
	Ontario	32,845
	Ashland	1,139
Action Alternative Groups (Hanford Only Waste Volume of TRU Waste)		
CH TRU waste	Ontario	5,221
RH TRU waste	Ontario	2,941
Total TRU Waste Shipments	Ontario	8,162
No Action Alternative (Hanford Only Waste Volume of TRU Waste)		
CH TRU Waste	Ontario	4,161

Route-specific stop times were estimated using the number of stops identified by TRAGIS routing analyses and an assumed 30-minute duration per stop. The accident-analysis parameters used in the RADTRAN 5 calculations were shown previously in Table H.8.

H.6.2 Non-Radiological Impact Analysis Parameters

Potential health effects from two non-radiological impact categories are estimated in this section: 1) impacts from traffic accidents (fatalities) and 2) impacts from incident-free emissions of vehicular pollutants (latent cancer fatalities). Both categories of impacts were calculated by combining unit rates (that is, fatalities per kilometer traveled), distance per shipment, and the number of shipments. Unit fatality rates for traffic accidents in Washington and Oregon were taken from Saricks and Tompkins (1999). Oregon traffic fatality rate data was incomplete in Saricks and Tompkins (1999), so national average fatality rates, which are about four times higher than the average rates in Washington, were used. The unit fatality rate for vehicular emissions was taken from Biwer and Butler (1999).

H.6.3 Analysis Results

The potential transportation impacts in Washington and Oregon for offsite shipments of LLW, MLLW, and TRU wastes are presented in Table H.31. The table includes the impacts in Washington and Oregon for both the Lower Bound and Upper Bound waste volumes. Table H.32 presents the impacts by state. The estimates in Table H.32 were calculated by scaling the overall results in Table H.31 by the ratio of the mileages in each state to the total mileage traveled in Washington and Oregon. Note in Table H.32 that 1 radiological fatality (worker plus public fatalities) is estimated for the Lower Bound waste volume, primarily due to shipments from Hanford to WIPP. Due to the higher volume of LLW and MLLW shipments for the Upper Bound waste volume than for the Lower Bound waste volume, the impact estimates are higher; that is, 1 radiological fatality and 1 non-radiological fatality from traffic accidents are estimated.

Table H.31. Impacts in Washington and Oregon from Shipments of Solid Waste to Hanford from Offsite and Shipments of TRU Wastes to WIPP[(a)]

Waste Type	Route	State	No of Shipments	Radiological Impacts, LCFs			Total Number of Accidents	Non-Radiological Impacts	
				Incident-Free Impacts					
				Worker	Public	Accidents		Number of Fatalities	Emissions LCFs
Lower Bound Waste Volume									
Shipments to Hanford									
LLW	Ontario	WA	1,297	6.8E-04	2.8E-03	4.5E-05	6.1E-02	1.3E-03	5.6E-03
		OR		2.2E-03	8.9E-03	1.4E-04	1.9E-01	1.8E-02	3.6E-03
	Ashland	WA	166	1.1E-04	6.8E-04	2.7E-05	7.8E-03	1.7E-04	7.9E-04
		OR		8.1E-04	5.1E-03	2.0E-04	5.7E-02	5.4E-03	9.1E-03
MLLW	Ontario	WA	10	5.3E-06	2.1E-05	4.2E-07	4.7E-04	1.0E-05	4.4E-05
		OR		1.7E-05	6.8E-05	1.3E-06	1.4E-03	1.4E-04	2.8E-05
	Ashland	WA	0	0	0	0	0	0	0
		OR		0	0	0	0	0	0
CH TRU waste	Ontario	WA	1	1.0E-06	8.6E-06	1.7E-08	4.7E-05	1.0E-06	4.4E-06
		OR		3.2E-06	2.7E-05	5.4E-08	1.4E-04	1.4E-05	2.8E-06
	Ashland	WA	1	1.2E-06	1.6E-05	6.2E-08	4.7E-05	1.0E-06	4.8E-06
		OR		9.3E-06	1.2E-04	4.6E-07	3.4E-04	3.2E-05	5.5E-05
RH TRU waste	Ontario	WA	29	2.7E-05	6.2E-04	4.2E-07	1.4E-03	2.9E-05	1.3E-04
		OR		8.7E-05	2.0E-03	1.3E-06	4.2E-03	4.0E-04	8.1E-05
	Ashland	WA	17	2.0E-05	6.9E-04	8.9E-07	8.0E-04	1.7E-05	8.1E-05
		OR		1.5E-04	5.2E-03	6.7E-06	5.8E-03	5.5E-04	9.3E-04
Shipments From Hanford to WIPP									
CH TRU waste	Ontario	WA	5,221	5.3E-03	4.5E-02	8.8E-05	2.5E-01	5.2E-03	2.3E-02
		OR		1.7E-02	1.4E-01	2.8E-04	7.5E-01	7.1E-02	1.5E-02
RH TRU waste	Ontario	WA	2,986	2.8E-03	6.4E-02	4.3E-05	1.4E-01	3.0E-03	1.3E-02
		OR		9.0E-03	2.0E-01	1.4E-04	4/3E-01	4.1E-02	8.3E-03
Total, all waste types to and from Hanford	Ontario	WA	9,544	8.8E-03	1.1E-01	1.8E-04	4.5E-01	9.6E-03	4.2E-02
		OR		2.8E-02	3.6E-01	5.7E-04	1.4	1.3E-01	2.7E-02
	Ashland	WA	184	1.3E-04	1.4E-03	2.8E-05	8.7E-03	1.8E-04	8.8E-04
		OR		9.7E-04	1.0E-02	2.1E-04	6.1E-02	5.8E-03	1.0E-02
Total by State	All	WA	9,728	8.9E-03	1.1E-01	2.1E-04	4.6E-01	9.7E-03	4.2E-02
		OR		2.9E-02	3.7E-01	7.7E-04	1.4E+00	1.4E-01	3.7E-02
Grand Total			9,728	3.8E-02	4.8E-01	9.8E-04	1.9	1.5E-01	7.9E-02
Upper Bound Waste Volume									
Shipments to Hanford									
LLW	Ontario	WA	14,436	7.6E-03	3.1E-02	5.1E-04	6.8E-01	1.4E-02	6.3E-02
		OR		2.4E-02	9.9E-02	1.6E-03	2.1	2.0E-01	4.0E-02
	Ashland	WA	943	6.1E-04	3.9E-03	1.5E-04	4.4E-02	9.5E-04	4.5E-03
		OR		4.6E-03	2.9E-02	1.1E-03	3.2E-01	3.1E-02	5.2E-02
MLLW	Ontario	WA	9,732	5.1E-03	2.1E-02	4.1E-04	4.6E-01	9.8E-03	4.2E-02
		OR		1.6E-02	6.6E-02	1.3E-03	1.4	1.3E-01	2.7E-02
	Ashland	WA	96	6.2E-05	3.9E-04	1.9E-05	4.5E-03	9.6E-05	4.6E-04
		OR		4.7E-04	3.0E-03	1.4E-04	3.3E-02	3.1E-03	5.3E-03

Table H.31. (contd)

CH TRU waste	Ontario	WA	171	1.7E-04	1.5E-03	2.9E-06	8.1E-03	1.7E-04	7.4E-04
		OR		5.5E-04	4.7E-03	9.2E-06	2.5E-02	2.3E-03	4.8E-04
	Ashland	WA	26	3.2E-05	4.3E-04	1.6E-06	1.2E-03	2.6E-05	1.2E-04
		OR		2.4E-04	3.2E-03	1.2E-05	8.9E-03	8.4E-04	1.4E-03
RH TRU waste	Ontario	WA	39	3.7E-05	8.4E-04	5.6E-07	1.8E-03	3.9E-05	1.7E-04
		OR		1.2E-04	2.7E-03	1.8E-06	5.7E-03	5.3E-04	1.1E-04
	Ashland	WA	74	8.6E-05	3.0E-03	3.9E-06	3.5E-03	7.4E-05	3.5E-04
		OR		6.5E-04	2.3E-02	2.9E-05	2.5E-02	2.4E-03	4.1E-03
Shipments From Hanford to WIPP (Ontario)									
CH TRU waste	Ontario	WA	5,415	5.4E-03	4.6E-02	9.1E-05	2.6E-01	5.4E-03	2.4E-02
		OR		1.7E-02	1.5E-01	2.9E-04	7.8E-01	7.4E-02	1.5E-02
RH TRU waste	Ontario	WA	3,052	2.9E-03	6.5E-02	4.4E-05	1.4E-01	3.1E-03	1.3E-02
		OR		9.2E-03	2.1E-01	1.4E-04	4.4E-01	4.2E-02	8.5E-03
Total, all waste types to and from Hanford	Ontario	WA	32,845	2.1E-02	1.7E-01	1.1E-03	1.5E+00	3.3E-02	1.4E-01
		OR		6.8E-02	5.3E-01	3.4E-03	4.7E+00	4.5E-01	9.2E-02
	Ashland	WA	1,139	7.9E-04	7.7E-03	1.8E-04	5.4E-02	1.1E-03	5.4E-03
		OR		6.0E-03	5.8E-02	1.3E-03	3.8E-01	3.6E-02	6.2E-02
Total by State	All	WA	33,984	2.2E-02	1.7E-01	1.2E-03	1.6E+00	3.4E-02	1.5E-01
		OR		7.4E-02	5.9E-01	4.7E-03	5.1E+00	4.8E-01	1.5E-01
Grand Total			33,984	9.6E-02	7.6E-01	5.9E-03	6.7E+00	5.9E-03	3.0E-01
Action Alternative Groups (Hanford Only Waste Volume of TRU Waste)									
CH TRU Waste	Ontario	WA	5,221	5.3E-03	4.5E-02	8.8E-05	2.5E-01	5.2E-03	2.3E-02
		OR		1.7E-02	1.4E-01	2.8E-04	7.5E-01	7.1E-02	1.5E-02
RH TRU Waste	Ontario	WA	2,941	2.8E-03	6.3E-02	4.2E-05	1.4E-01	2.9E-03	1.3E-02
		OR		8.9E-03	2.0E-01	1.3E-04	4.3E-01	4.0E-02	8.2E-03
Total by State	**All**	WA	8,162	8.0E-03	1.1E-01	1.3E-04	3.8E-01	8.2E-03	3.6E-02
		OR		2.6E-02	3.4E-01	4.2E-04	1.2E+00	1.1E-01	2.3E-02
Grand Total			8,162	3.4E-02	4.5E-01	5.5E-04	1.6E+00	5.5E-04	5.8E-02
No Action Alternative (Hanford Only Waste Volume of TRU Waste)									
CH TRU Waste	Ontario	WA	4,161	4.2E-03	3.6E-02	7.0E-05	2.0E-01	4.2E-03	1.8E-02
		OR		1.3E-02	1.1E-01	2.2E-04	6.0E-01	5.7E-02	1.2E-02
	All		4,161	1.8E-02	1.5E-01	2.9E-04	8.0E-01	6.1E-02	3.0E-02

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

Table H.32. Impacts in Washington and Oregon by State from Offsite Shipments of Solid Wastes to and from Hanford[(a)]

State	Radiological Incident-Free LCFs		Radiological Accident LCFs	Total Number of Accidents	Non-Radiological Impacts	
	Worker	Public			Number of Fatalities	Emissions LCFs
Lower Bound Waste Volume						
WA	0.0089	0.11	0.00021	0.46	0.0097	0.042
OR	0.029	0.37	0.00077	1.4	0.14	0.037
Total	0 (0.038)	0 (0.48)	0 (0.00098)	2 (1.9)	0 (0.15)	0 (0.079)
Upper Bound Waste Volume						
WA	0.022	0.17	0.0012	1.6	0.034	0.15
OR	0.074	0.59	0.0047	5.1	0.48	0.15
Total	0 (0.096)	1 (0.76)	0 (0.0059)	7 (6.7)	1 (0.52)	0 (0.3)
Action Alternative Groups (Hanford Only Waste Volume of TRU Waste)						
WA	0.008	0.11	0.00013	0.38	0.0083	0.036
OR	0.026	0.34	0.00042	1.2	0.11	0.023
Total	0 (0.034)	0 (0.45)	0 (0.00055)	2 (1.6)	0 (0.12)	0 (0.058)
No Action Alternative (Hanford Only Waste Volume of TRU Waste)						
WA	0.0042	0.036	0.00007	0.2	0.0042	0.018
OR	0.013	0.11	0.00022	0.6	0.057	0.012
Total	0 (0.18)	0 (0.15)	0 (0.00029)	1 (0.8)	0 (0.061)	0 (0.03)

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting non-radiological fatalities. Non-radiological emissions impacts are expressed as LCFs.

H.7 Results of Hazardous Chemical Impact Analysis

Downwind concentrations of hazardous chemicals released from a severe transportation accident are presented in this section. The resulting chemical concentrations are put in perspective by comparing them to safe exposure levels. The methods used are standard facility safety analysis techniques and are proven methods for assessing potential health effects from accidental releases of hazardous chemical materials. In addition, the impacts presented in this section are representative of the potential hazardous chemical impacts of a terrorist attack on a waste shipment.

The hazardous chemical constituents of MLLW and TRU wastes to be transported to and on the Hanford Site were shown previously in Table H.10. The downwind concentrations shown in Table H.33 were calculated assuming a shipment of maximum-inventory 208-L (55-gal) drums is involved in a severe accident and releases 0.5 percent of the total inventory of each hazardous chemical as respirable particles into the environment. The downwind concentrations are then compared to Temporary Emergency Exposure Limit-2 (TEEL-2) values given by Craig (2002). The TEEL-2 definition follows.

TEEL-2: The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

TEEL-2 values are used here instead of the more widely accepted Emergency Response Planning Guidelines (ERPGs), because ERPG values do not exist for some of the chemicals listed in Table H.33. TEEL values are interim replacements for the peer-reviewed ERPG values and may be used when ERPG values are not available. ERPG-2 is analogous to TEEL-2 and is defined as follows:

ERPG-2: The maximum concentration in air below which it is believed that nearly all individuals could be exposed *for up to 1 hour* without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

The difference between TEEL-2 and ERPG-2 is that, for application of TEELs, the concentration at the receptor point is calculated as the peak 15-minute, time-weighted average.

The results of the hazardous-chemical-concentration calculations are shown in Table H.33. The results indicate that downwind concentrations of the hazardous chemicals would not exceed the TEEL-2 guidelines following a severe transportation accident involving a shipment of maximum-inventory 208-L (55-gal) drums. Additional analyses were performed to determine the impacts of assuming that all of the released materials become volatilized under the thermal effects of a transportation-related fire. This was done by changing the aerosol and respirable release fractions of all of the chemicals to 1.0. This resulted in three chemicals exceeding their TEEL-2 concentrations. These three chemicals are elemental lead, elemental mercury, and beryllium. The downwind concentrations of these three chemicals were then compared to their Immediately Dangerous to Life and Health (IDLH) values for an additional perspective. The exposure guideline concentrations are defined as follows:

TEEL-3: The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

ERPG-3: The maximum concentration in air below which it is believed nearly all individuals could be exposed *for up to one hour* without experiencing or developing life-threatening health effects.

IDLH: The maximum concentration from which, in the event of respirator failure, a person could escape within 30 minutes without a respirator and without experiencing any escape-impairing (for example, severe eye irritation) or irreversible health effects.

The IDLH values for beryllium, lead, and mercury are 10, 700, and 4.1 mg/m^3, respectively. The downwind concentrations of all three of these chemicals are below their respective IDLH values.

The downwind concentration of beryllium was found to exceed its ERPG-3 concentration. However, the downwind concentrations of all three of the chemicals are below their respective IDLH values. Based on these observations, the conclusion is that releases of hazardous chemicals from transportation accidents are unlikely to result in a fatality.

Table H.33. Hazardous Chemical Concentrations 100 m (109 yd) Downwind from Severe Transportation Accidents (mg/m^3)

	CH MLLW	RH MLLW	MLLW Ready for Disposal	RH TRU Waste Boxes	CH TRU with PCBs	RH TRU Waste in Trenches	Elemental Lead	Elemental Mercury	TEEL-2[(a)]
Acetone	6.9E-03	6.7E-03	6.9E-03	2.6E-05	0	0	0	0	20,000
Beryllium	8.9E-04	8.9E-04	8.9E-04	8.4E-05	8.4E-05	8.4E-05	0	0	0.025
Bromodichloro-methane	3.9E-05	0	3.9E-05	0	0	0	0	0	30
Carbon tetrachloride	1.4E-02	0	1.4E-02	4.5E-03	0	0	0	0	639
Diesel fuel	2.7E-05	0	2.7E-05	0	0	0	0	0	500
Formic acid	3.2E-02	0	3.2E-02	0	0	0	0	0	15
Lead	0	0	0	0	0	0	1.6E-01	0	0.25
Methyl ethyl ketone (MEK or 2 Butanone)	5.4E-03	0	5.4E-03	0	0	0	0	0	750
Mercury	8.3E-06	0	8.3E-06	8.1E-07	0	0	0	2.3E-02	2.05
Nitrate	7.8E-03	0	0	0	0	0	0	0	50
Nitric acid	2.3E-01	2.3E-01	2.3E-01	0	0	0	0	0	15
Polychlorinated biphenyls (PCBs)	9.7E-05	0	9.7E-05	0	3.0E-04	0	0	0	1
p-Chloroaniline	1.9E-02	0	1.9E-02	0	0	0	0	0	50
Sodium hydroxide	3.2E-01	3.2E-01	3.2E-01	1.7E-02	1.7E-02	1.7E-02	0	0	5
Toluene	1.2E-02	3.6E-01	1.2E-02	0	0	0	0	0	1,125
1,1,1-Trichloroethane	2.5E-02	0	2.5E-02	2.6E-05	0	0	0	0	3,850
Xylene	2.1E-03	3.4E-02	2.1E-03	1.4E-04	1.6E-01	1.6E-01	0	0	750

(a) Source: Craig (2002).

The downwind hazardous chemical concentrations are calculated for a person 100 m (109 yd) away from the release point. This assumption is conservative for a member of the public, either offsite or onsite, who is unlikely to be 100 m (109 yd) from the release point for the entire duration of the release. In addition, the release duration used in these calculations was assumed to be 15 minutes. It is unlikely that an impact followed by a fire event would cause the dispersible fraction of the package contents to be released in such a short duration—the release duration is likely to be much longer, perhaps as much as one to two hours, and thus the peak concentrations at the receptor location likely will be lower. Furthermore, the maximum hazardous-chemical concentration for each waste type was modeled. This model includes, in the case of MLLW, 16 hazardous chemicals. It is extremely unlikely that any single 208-L (55-gal) drum would contain the maximum concentrations of all 16 hazardous chemicals. This information provides additional evidence that the results shown in Table H.33 are bounding.

The potential downwind concentrations of hazardous chemicals presented in Table H.33 also were considered to represent those that could occur from a terrorist attack. Note that no fatalities are projected to occur as a result of the exposure to hazardous chemicals. However, the radiological impacts of potential terrorist attacks (see Section H.3.2.3.2) may result in an inferred fatality (that is, an LCF). Therefore, the dominant potential impacts of a terrorist attack are from the release of radioactive materials.

H.8 Potential Impacts of Sabotage or Terrorist Attack

This section addresses the potential environmental impacts from sabotage or terrorist attacks on shipments of solid waste to and from the Hanford Site. The U.S. Department of Transportation has recently issued new requirements (see 68 FR 14510) for development and implementation of security plans for radioactive material shipments. The security plans must assess the security risks posed by the shipments and measures taken to address these risks, including personnel and en route security measures as well as measures taken to prevent unauthorized access. The DOE also has requirements that address the physical security of waste shipments (DOE 2002c), one of which requires preparation of a transportation plan that includes descriptions of cargo security arrangements, as appropriate. In addition to these requirements, DOE complies with the DOT and DOE regulations as described in Section 2.2.4.

These requirements are intended to minimize the possibility of sabotage and facilitate recovery of shipments that could fall under the control of unauthorized persons. The requirements are designed to minimize the impacts of malevolent acts during transport. Truck drivers for all hazardous material shipments are required to receive security training (68 FR 14510). The training must provide an awareness of security risks, recognition of potential security threats, and methods of responding to potential security threats. Truck drivers and other employees of hazardous material transportation companies that are required to have a security plan must receive in-depth training on the security plan and its implementation, including specific security procedures and actions to take in the event of a security breach. In accordance with DOE (2002b), DOE's Office of Transportation Safeguards conducts drills and exercises on a regular basis, including annual in-service tests with DOE and state response elements. Finally, DOE supports and provides assistance in the area of emergency preparedness and emergency response to transportation incidents, including sabotage events and terrorist attacks. These rules apply to offsite shipments in the general-public domain where conditions along transport routes cannot be controlled.

The shipping containers, themselves, provide substantial protection. Type B accident-resistant packaging systems are required for the most hazardous shipments, such as TRU wastes, and certain higher-radioactivity LLW and MLLW shipments, as well as ILAW containers. These packaging systems would provide a substantial amount of protection from terrorist attacks. As discussed in Section H.2, Type B packages are designed to withstand a series of hypothetical accident conditions that simulate the mechanical and thermal conditions a package could potentially be exposed to in a severe transportation accident. These hypothetical accident conditions include free drop onto an unyielding surface, drop onto a steel puncture probe, exposure to a long-duration engulfing fire, and immersion under water. Lower-hazard materials, including most LLW and MLLW shipments, are shipped in Type A packages. The less-hazardous shipments are considered unlikely to be attractive as terrorist targets because they would not involve a high-profile symbol of the United States nor would a successful attack produce a large number of immediate fatalities or injuries.

It is not possible to predict the likelihood of sabotage events or terrorist attacks or the nature of such events. The impacts of severe transportation accidents were used to approximate the potential impacts of a successful terrorist attack on a shipment of radioactive waste. In general, the most severe transportation accidents would involve high-speed impact conditions that result in functional failure or breach of the shipping container (for example, TRUPACT-II) and internal packaging (for example, 208-liter or 55-gal drums) fired by a long-duration engulfing fire that causes further functional failure and dispersal of the package contents. A potential terrorism event would involve a similar progression, that is, breach of external and internal packaging and exposure of the contents to thermal as well as explosion conditions that would lead to a release of and dispersal of the radioactive cargo.

The estimated consequences of a successful terrorist attack on a spent nuclear fuel shipment would bound the potential impacts on shipments of LLW, MLLW, and TRU wastes. This is because of the much greater radionuclide inventories in spent nuclear fuel than in the radioactive wastes to be shipped to or from Hanford. A recent study (Luna et al. 1999) investigated the potential damage effects of two explosive devices that might be used by terrorists on a spent nuclear fuel shipping cask. The devices were shown to be capable of penetrating the spent nuclear fuel shipping cask's thick shield wall and could lead to dispersal of a fraction of the radioactive material. It is postulated in the HSW EIS that the devices also would be capable of penetrating the shipping containers used to transport LLW, MLLW, and TRU wastes. However, the radionuclide inventories in spent nuclear fuel shipments are much larger than the radionuclide inventories in LLW, MLLW, and TRU waste shipments. In comparing the inventories in CH and RH TRU waste shipments (see Table H.10) with those of a spent nuclear fuel assembly (DOE 2002b), it was found that the inventories of plutonium isotopes are 2 to 2400 times higher in a spent nuclear fuel assembly than in TRU waste shipments. The inventory of americium-241 is 100 to 400 times higher and the inventories of cesium-137 and strontium-90 are about 500 times higher in a spent nuclear fuel assembly. Based on these comparisons, spent nuclear fuel represents a substantially higher hazard than CH or RH TRU waste. Shipments of LLW and MLLW, which contain no or only trace amounts of plutonium and americium, represent lower hazards than TRU wastes. Based on these comparisons, DOE concluded that the potential impacts of a successful terrorist attack on a spent nuclear fuel shipment would bound the potential impacts of a similar attack on LLW, MLLW, and TRU waste shipments.

Based on the above discussion, the potential impacts of a terrorist attack on a shipment of radioactive materials covered in this HSW EIS were approximated using the consequences of a successful attack on a spent nuclear fuel shipment (DOE 2002b). The results indicated that such an attack, if conducted successfully in an urban area under stable atmospheric conditions, could result in a population dose of about 96,000 person-rem. Such a population dose would result in about 24 excess LCFs in the exposed population. Maximally exposed individuals could potentially receive a committed dose of 110 rem, which is well below the exposure level that would result in an immediate radiation-induced fatality and would increase the individual's probability of an LCF by about 7 percent. If the attack occurred in a less-densely populated area, the consequences would be much lower. Also, as discussed in Section H.3.2.3.2, a severe but highly unlikely transportation accident in an urban area involving a bounding inventory TRU waste shipment could result in a population dose of about 32,000 person-rem, or about 16 LCFs. Maximum individual doses due to these accidents would be about 120 rem, or an LCF probability of about 0.08. The actual consequences likely would be lower because the vast majority of RH TRU waste shipments would contain less radioactivity than the bounding inventory. These are conservative estimates because they assume that the attack results in complete loss of containment. In addition, interdiction and other measures that would lessen the impacts are not taken into account. A successful terrorist attack on a shipment of LLW or MLLW would involve less-hazardous radionuclide inventories than TRU wastes or spent nuclear fuel and would be expected to have correspondingly smaller consequences.

The potential hazardous chemical impacts of a successful terrorist attack were approximated by increasing the amount of hazardous waste material dispersed as a result of a severe accident to more than that assumed in Section H.7. The additional release quantity would represent the potential additional material that would be available for release due to the explosive effects of a high-energy device that could be used by terrorists. It was assumed that the entire truckload of waste containers would be breached by the explosive device, leading to release and dispersal of the cargo. As was done in Section H.7, a respirable release fraction of 0.5 percent was applied to solid materials and 100 percent of the volatile chemicals were assumed to be released. The analysis did not account for the effects of increased dispersion by the explosive device, combustion of the hazardous materials that would result in a less-toxic material, or any processes that would reduce dispersal (for example, vapor plate-out, particle settlement/deposition, and chemical reactions). All of these phenomena would lessen the impacts. The results indicate that the concentrations of four chemicals—elemental lead, elemental mercury, elemental beryllium, and sodium hydroxide—could exceed the ERPG-2 (or equivalent TEEL-2) guidelines. This is one more chemical (that is, sodium hydroxide) than would potentially exceed the ERPG-2 concentrations after a severe transportation accident (see Section H.7). None of the chemical concentrations exceeds the ERPG-3 (or equivalent TEEL-3) concentrations.

An additional element to consider is most of the shipments of radioactive waste covered in this HSW EIS are within Hanford Site boundaries. Hanford is a controlled-access facility that is protected by various security measures, for example, security guards and visual surveillance systems. Onsite shipments of solid waste would be protected by these same systems, which lessen the likelihood of a successful terrorism incident at Hanford.

H.9 Comparison of HSW EIS Transportation Impacts to Those in Other Environmental Impact Statements

Two recent program-level EISs have been completed by DOE that address nationwide transportation of radioactive and hazardous wastes to or from the Hanford Site, including LLW, MLLW, and TRU wastes considered as part of the HSW EIS. The *Final Waste Management Programmatic Environmental Impact Statement* (WM PEIS, DOE 1997a) evaluated various aspects of managing radioactive and hazardous wastes across all DOE sites. The *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (WIPP SEIS-II, DOE 1997b) evaluated nationwide management of TRU wastes, including transportation to and disposal at WIPP. The following sections compare the scope, methods, data, and results among these studies.

H.9.1 Comparison to the Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

The WM PEIS (DOE 1997a) evaluated the nationwide impacts of managing four types of radioactive (LLW, MLLW, TRU wastes, and high-level waste) and hazardous wastes. The purpose of the WM PEIS was to evaluate alternatives concerning configurations of sites for waste management activities. A Record of Decision (ROD) on the management of LLW and MLLW was issued on February 25, 2000 (65 FR 10061). DOE decided, among other things, to continue onsite disposal of LLW at four DOE sites and to make Hanford and the Nevada Test Site (NTS) available to DOE sites for the disposal of LLW and MLLW.

The HSW EIS and WM PEIS analyzed similar configurations for the treatment and disposal of LLW and MLLW; however, the HSW EIS used updated, state-of-the-art methods for calculating transportation impacts. For example, the WM PEIS used the HIGHWAY computer code (Johnson et al. 1993) for calculating route characteristics, whereas the HSW EIS used the TRAGIS computer code (Johnson and Michelhaugh 2000). The WM PEIS used RADTRAN 4 (Neuhauser and Kanipe 1992); the HSW EIS used RADTRAN 5 (Neuhauser et al. 2003) code to calculate radiological impacts. The WM PEIS used a non-radiological emissions approach and risk factors developed by Rao et al. (1982) and the HSW EIS used the approach and risk factors from Biwer and Butler (1999). In addition, more recent data sources were used in the HSW EIS that were not available when the WM PEIS was prepared, such as the 2000 population census information. Although these minor differences in approach led to somewhat different numerical results, the conclusions of the two documents are similar.

Comparisons were made between the transportation impacts calculated in the WM PEIS and HSW EIS in an effort to understand what the differences are, if any. The WM PEIS information was taken from the *Information Package on Pending Low-Level Waste and Mixed Low-Level Waste Disposal Decisions to be Made under the Final Waste Management Programmatic Environmental Impact Statement* (DOE 1998a) that was developed to support the February 25, 2000, LLW and MLLW ROD. The *Information Package* was prepared to enable the selection of preferred sites. It analyzed six options for disposal of LLW and five options for MLLW disposal. The *Information Package* summarized information from the original WM PEIS and conducted scaling analyses based on the original WM PEIS to support the site selection decisions described in the *Identification of Preferred Alternatives for the Department of Energy's Waste Management Program: Low-Level Waste and Mixed Low-Level Waste Disposal Site* (64 FR 69241) and the subsequent ROD (65 FR 10061). The comparisons were made against LLW Disposal Option 2 and MLLW Disposal Option D. In both of these options, substantial volumes of LLW (about 100,000 m^3) and MLLW (about 40,000 m^3) are shipped from offsite to Hanford for disposal.

A comparison of the offsite LLW and MLLW volumes shipped to Hanford and the radiological and non-radiological impacts in DOE (1998a) and the associated *Information Package* is presented in Table H.34. The comparisons indicate that the results presented in the HSW EIS for the Upper Bound waste volume are consistent with those in DOE (1998a). The offsite LLW volumes and impacts are about a factor of 2 different, based largely on the differences in the time frames analyzed in the two documents

(20 years for the WM PEIS, 43 years for the HSW EIS). Similarly, the offsite MLLW volumes and impacts are about a factor of 3 different. Consequently, even though there are differences in key assumptions, such as the waste volumes and specific generator sites that ship LLW and MLLW to Hanford, census data (that is, 1990 versus 2000 Census), accident fatality rates, the emissions approach and risk factors, and different computer codes that were used, the results between the two studies are comparable after adjusting for the increased waste volume in the HSW EIS. Note that an important input parameter to the radiological impact calculations is the TI, or radiation dose rate, at 1 m from the package. This parameter is the same for both studies, which accounts largely for the similarities in radiological impacts.

Non-radiological impacts are also similar between the HSW EIS and the WM PEIS after adjusting for the increased waste volume in the HSW EIS. The two most important input parameters to the non-radiological impacts are the shipping characteristics (that is, mileages and population zone information) and fatality rates. Reviews of the rates used in the WM PEIS (Saricks and Kvitek 1994) and the HSW EIS (Saricks and Tompkins 1999) were conducted to identify trends in the data. It was discovered that the results were recorded differently in the two EIS's and, thus, are difficult to compare on a state-by-state basis. However, the United States mean fatality rate on interstate highways is somewhat lower in Saricks and Tompkins (1999) (8.8E-9 fatalities/km) than in Saricks and Kvitek (1994) (2.03E-8 fatalities/km). This would tend to decrease the overall impacts calculated in the HSW EIS relative to the WM PEIS. The population densities along the routes were observed to increase somewhat due to the incorporation of 2000 Census data into TRAGIS (Johnson and Michelhaugh 2000). This would tend to cause the calculated non-radiological fatalities in the HSW EIS to be higher than the WM PEIS. Therefore, it appears that updates to these two parameters have essentially offset each other.

This exercise led to the following observation. Waste volume assumptions appear to be the main factor behind the differences between the WM PEIS, the WM PEIS *Information Package,* and the HSW EIS. The WM PEIS transportation calculations were based on 20 years, whereas the HSW EIS covers the lifecycle of the Hanford Solid Waste Management Program (through 2046). Consequently, the LLW and MLLW volume projections are different, leading to differences in the potential transportation impacts. In addition, the WM PEIS was published in 1997, so the waste-volume projections are several years older than the waste-volume projections used in the HSW EIS. The HSW EIS volumes from offsite represent more recent information from generator sites and are more current than waste volumes analyzed in the WM PEIS.

Table H.34. Comparison of Offsite LLW and MLLW Volumes and Impacts Between the WM PEIS, the WM PEIS Information Package, and the HSW EIS

Category	WM PEIS(a)	WM PEIS Information Package(b)	HSW EIS Upper Bound Waste Volume
Low-Level Waste			
LLW Volume Shipped to Hanford, m^3	~1,400,000 (20 years)	~100,000 (20 years)	~220,000 (43 years)
Radiological Incident-Free Impacts, LCFs(c)	15	0.5(a)	1.4
Non-Radiological Fatalities(d)	35	1.2	2.1
Mixed Low-Level Waste			
MLLW Volume Shipped to Hanford, m^3	~60,000 (20 years)	~40,000 (20 years)	~140,000 (43 years)
Radiological Incident-Free Impacts, LCFs(c)	0.4	0.2	0.8
Non-Radiological Fatalities(d)	0.9	0.4	1.2

NOTE: Use caution when comparing these values, because transportation impacts are a function of total shipping distance traveled and route characteristics between the shipping origin and destination sites. It was not possible to definitively determine which specific sites were assumed to ship to Hanford in the WM PEIS and WM PEIS Information Package, so there is substantial uncertainty associated with comparisons among these values.

(a) Source = WM PEIS (DOE 1997a). LLW volumes and impacts are for the WM PEIS Centralized 1 Alternative in which Hanford is the sole LLW disposal site. MLLW volumes and impacts are for WM PEIS Centralized Alternative for MLLW in which Hanford is the only MLLW disposal site.
(b) Source = Information Package (DOE 1998a). LLW and MLLW volumes shipped to Hanford and associated impacts are for LLW Disposal Option 2 and MLLW Disposal Option A, respectively.
(c) Includes worker and public LCFs from incident-free transportation.
(d) Includes non-radiological fatalities from traffic accidents and LCFs from incident-free non-radiological emissions.

H.9.2 Comparison to the Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement

The transportation impact analysis in the WIPP SEIS-II (DOE 1997b) was compared to the HSW EIS transportation impact analysis. Only the TRU waste transportation impact analyses are compared because DOE (1997b) only included analyses of TRU waste transportation impacts.

The HSW EIS used updated methods and data relative to DOE (1997b), including updated waste volume projections. Key differences in these areas are summarized below:

- In the HSW EIS, the transportation impact calculations were conducted using the RADTRAN 5 computer software. The computer code used in DOE (1997b) was the previous version of the computer software (that is, RADTRAN 4).

- The most recent highway routing model; that is, the GIS-based TRAGIS computer code, was used in the HSW EIS, whereas the HIGHWAY computer code was used in WIPP SEIS-II. Two completely different routing analysis methodologies are used in these codes. In addition, the TRAGIS outputs used in the HSW EIS are based on the 2000 Census data whereas the WIPP SEIS-II routing analyses were based on the 1990 Census.

- The HSW EIS TRU waste volume projections are more recent than the waste volume projections used in the WIPP SEIS-II. The HSW EIS TRU waste volume projections represent the current maximum forecast TRU waste volumes, including the TRU wastes already onsite, to be generated onsite, and to be shipped to Hanford from offsite.

- The HSW EIS used the non-radiological emissions impact methodology described by Biwer and Butler (1999). The WIPP SEIS-II used the methodology described by Rao et al. (1982). In general, application of Biwer and Butler (1999) resulted in more conservative (that is, the tendency to overstate potential impacts) emissions impact estimates due in part to higher incremental mortality estimates for a given exposure level (DOE 2002a).

- Non-radiological accident impacts were calculated using a similar approach in both the WIPP SEIS-II and the HSW EIS. However, the analyses in the HSW EIS used updated accident statistics relative to the WIPP SEIS-II. The impacts are somewhat smaller in the HSW EIS due to lower accident and fatality rates on the highway route between Hanford and WIPP. The other key reason is a decline in the projected number of shipments from Hanford to WIPP.

Table H.35 provides a comparison of some key results of the WIPP SEIS-II and HSW EIS impact analyses.

Number of CH TRU waste shipments. The projected number of shipments of CH TRU waste from Hanford to WIPP in the HSW EIS is lower than the preferred alternative in the WIPP SEIS-II. The projected number of RH TRU waste shipments in the HSW EIS is approximately the same as the preferred alternative in WIPP SEIS-II.

Radiological incident-free LCFs (public plus worker). Potential **r**adiological incident-free LCFs are higher in the HSW EIS than WIPP SEIS-II, even though the number of shipments is lower. The main reason for the higher incident-free LCFs is the enhanced precision of the routing model used in the HSW EIS, which resulted in longer travel distances in urban and suburban areas than were determined in the WIPP SEIS-II. In addition, the HSW EIS uses 2000 Census data whereas WIPP SEIS-II used the 1990 Census data. The effects of these two elements of the incident-free exposure analysis compound each

Table H.35. Comparison of Potential Transportation Impacts for Shipments of TRU Waste from Hanford to WIPP

Category	WIPP SEIS-II[(a)]	HSW EIS
CH TRU Waste		
Number of CH TRU Waste Shipments	13,666	5,415
Radiological Incident-Free LCFs (public plus worker)	1.9	2.1
Radiological Accident LCFs	0.3	0.006
Non-Radiological Accidents (number)	26	12
Non-Radiological Fatalities	2.3	0.4
Non-Radiological Emissions LCFs	0.1	0.2
RH TRU Waste		
Number of RH TRU Waste Shipments	3,178	3,052
Radiological Incident-Free LCFs (public plus worker)	0.4	2.7
Radiological Accident LCFs	0.004	0.003
Non-Radiological Accidents (number)	6	6
Non-Radiological Fatalities	0.5	0.2
Non-Radiological Emissions LCFs	0.02	0.1
(a) Source = DOE (1997b) or derived from information contained therein.		

other. First, population growth has increased the number of exposed individuals along the transportation routes. Second, the TRAGIS output from the HSW EIS analysis had longer shipping distances in urban and suburban areas than were determined in the WIPP SEIS-II. This not only increases the number of potentially exposed individuals, it increases travel time in these areas, which increases exposure durations and, thus, increases the population dose. In addition, the dose-to-LCF conversion factor is higher in the HSW EIS than the WIPP SEIS-II. These effects more than offset the higher urban population densities that were used in the WIPP SEIS-II.

Radiological accident LCFs. Potential radiological accident impacts are lower in the HSW EIS than the WIPP SEIS-II. The main reason for this difference appears to be that the WIPP SEIS-II used a generic, national-average accident rate in the accident risk calculations from NUREG-0170 (NRC 1977). The approach used in the HSW EIS was to compute route-specific accident rates and use those rates to calculate the accident risks. There is 1 order of magnitude, or more, difference between the generic accident rate derived by NRC (1977) and that used in the WIPP SEIS-II to calculate the risks of accidental releases of radioactive material in transit and the route-specific accident rates used in the HSW EIS. In any event, this does not affect the overall total radiological impact estimates because the total estimates are, in general, dominated by incident-free impacts.

Non-radiological accidents (number) and non-radiological fatalities. Potential non-radiological accident impacts for CH TRU waste shipments are somewhat lower in the HSW EIS and potential RH TRU waste shipment impacts are approximately the same as those reported for the WIPP SEIS-II preferred alternative. The main differences in the results arise from the reduced number of CH TRU waste shipments and slightly lower accident and fatality rates used in the HSW EIS. RH TRU waste shipments are approximately the same. While similar approaches were used (that is, application of state-specific accident and fatality rates), the data used to calculate non-radiological accidents and fatalities in the HSW EIS are more current than those used in the WIPP SEIS-II.

Non-radiological emissions LCFs. Potential non-radiological emissions impact estimates are lower on a per-shipment basis in the WIPP SEIS-II than in the HSW EIS. These differences are due to the methodologies employed. Based on the results, the increases due to implementation of Biwer and Butler (1999) more than offset the reductions that would result from the lower number of projected CH TRU waste shipments and result in increased impacts due to RH TRU waste shipments.

In spite of these differences in computational tools and data, the overall impact estimates are similar. Despite the minor differences in numerical results between the two EIS's in terms of the total radiological (sum of radiological incident-free and accidental LCFs) and non-radiological impacts (sum of non-radiological accident fatalities and emissions LCFs), the conclusions of the two documents are comparable.

H.10 Effects of Transporting Solid Waste by Rail

The analyses in this appendix assumed that all of the onsite and offsite shipments of solid waste would be conducted using trucks over existing roads. It is possible that some of the shipments of solid waste and construction and/or capping materials could be transported by rail. Rail shipments generally result in lower impacts than truck shipments. These lower impacts for rail relative to truck shipping are documented in numerous EIS's (DOE 2002b; 1997a; 1997b). Generally, rail shipments result in lower impacts than truck shipments for a variety of reasons:

- Rail payload capacity is substantially greater than truck. This results in fewer shipments, which, in turn, results in lower transportation impacts.

- There are fewer people sharing rail lines than are sharing highways with truck shipments. This is somewhat offset by the lower average speeds for rail shipments, which increases the exposure time relative to truck shipments.

- When a rail shipment stops at a railyard, there are many other railcars that provide shielding between the shipping container and people. This shielding results in lower radiation dose rates, and thus lower radiation exposures, to bystanders and people living in the vicinity of rail stops relative to truck stops.

- According to recent data from Saricks and Tompkins (1999), fatality rates for truck and rail transport are comparable. For example, the nationwide accident and fatality rates for truck shipments are about 3.2E-07 accidents per truck-km and 1.4E-08 fatalities per truck-km, respectively (see Table 4 of Saricks and Tompkins [1999]). For rail shipments, the comparable nationwide accident rate is about 5.4E-08 accidents per railcar-km and the fatality rate is about 2.1E-08 fatalities per railcar-km (see Table 6 of Saricks and Tompkins [1999]). Although the fatality rate on a per-km basis is higher for rail than for truck shipments, the rail shipments travel fewer miles than truck shipments due to the higher payload capacity of the rail shipments. The higher payloads for rail shipments more than offset the difference in fatality rates, resulting in lower non-radiological accident impacts for rail shipments.

While rail shipments generally result in lower radiological incident-free and non-radiological accident impacts than truck shipments, the impacts of radiological accidents are likely to be higher for rail shipments. Recall that radiological accident impacts are calculated as the product of the frequency of an accident times its consequences. While the probability of a severe accident is comparable between the two modes as discussed above, the consequences of a severe rail accident could be greater due to the higher payload of rail shipments relative to truck shipments; that is, larger quantities of radioactive materials would be released from a rail shipment than a truck shipment. This leads to generally higher radiological accident impacts for rail shipments relative to truck shipments. However, a review of the impact estimates in Tables H.15 (onsite shipments) and H.17 (offsite shipments) indicates that radiological accident impacts are a small fraction of the radiological incident-free and non-radiological impacts. Therefore, the radiological accident impacts do not contribute substantially to the total impacts.

Although predicted impacts for rail shipments likely would be smaller than for truck shipments, a number of other variables must also be considered. First, general freight rail service is slower than truck shipping, resulting in longer travel times and possibly long stop times in rail yards waiting for train makeup. The longer shipping times for rail shipments may also lead to less efficient use of DOE shipping containers, depending on the waste types transported by rail and the truck/rail mix of the shipping campaigns. Second, not all generator sites, including Hanford, have rail service. In order for these sites to use rail service, new rail lines would have to be constructed, existing lines that have been abandoned would have to be rebuilt, or truck/rail intermodal transportation would have to be implemented (that is, deliver truck shipments to a railyard where the shipping containers would be offloaded from the trucks and loaded onto a rail car for subsequent transport; the opposite operation would be required for receiving sites not provided with rail service). This could lead to increased costs as well as increased impacts due to the additional handling activities required to offload and reload the containers onto or off of the railcars. Third, if a rail accident involving a derailment were to occur, the rail line could be disabled for a lengthy period of time. Although truck accidents also could involve closure of a highway, there is a greater potential for a detour around a closed highway than around a closed rail line.

There are two types of rail service available for radioactive waste shipments: 1) general freight rail, in which the railcars carrying the wastes would be added to an existing train and 2) dedicated rail service, in which a train would be made up solely of railcars carrying radioactive wastes to and/or from Hanford plus locomotives and buffer cars as needed. According to the *Final Environmental Impact Statement for the Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002b), dedicated rail service offers advantages over general freight rail service in incident-free transport but could lead to higher accident impacts. It was concluded that available information does not indicate a clear advantage for the use of either general freight or dedicated train service (DOE 2002b).

A final point relative to rail shipping is that the Hanford waste management facilities currently do not have rail service. New rail spurs and upgrades to existing rail lines would be needed to reach the Hanford solid waste management facilities. At this time, it is too speculative to assume that rail access to solid waste management facilities on the Hanford Site would be available, and an analysis of rail transport at this time does not appear warranted.

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